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SVM150-A
September, 2002

Ranger™ 250

For use with machines having Code Numbers: **10654**

Safety Depends on You

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation . . . and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

SERVICE MANUAL

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LINCOLN® ELECTRIC

• World's Leader in Welding and Cutting Products •
• Sales and Service through Subsidiaries and Distributors Worldwide •
Cleveland, Ohio 44117-1199 U.S.A. TEL: 216.481.8100 FAX: 216.486.1751 WEB SITE: www.lincolnelectric.com

SAFETY

⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

The Above For Diesel Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

The Above For Gasoline Engines

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE powered equipment.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

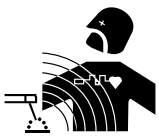
1.d. Keep all equipment safety guards, covers and devices in position and in good repair.Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.

1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.



ELECTRIC AND MAGNETIC FIELDS may be dangerous

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

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SAFETY

ELECTRIC SHOCK can kill.

3.a. The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- **Semiautomatic DC Constant Voltage (Wire) Welder.**
- **DC Manual (Stick) Welder.**
- **AC Welder with Reduced Voltage Control.**

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.

ARC RAYS can burn.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

FUMES AND GASES can be dangerous.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases.When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and below Threshold Limit Values (TLV) using local exhaust or mechanical ventilation. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.**

5.b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.c. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.d. Read and understand the manufacturer’s instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer’s safety practices. MSDS forms are available from your welding distributor or from the manufacturer.

5.e. Also see item 1.b.

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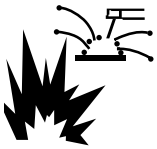


WELDING SPARKS can cause fire or explosion.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

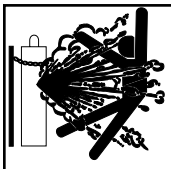
6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.



CYLINDER may explode if damaged.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:

- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-l, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.

FOR ELECTRICALLY powered equipment.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

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PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté specifiques qui parraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protegez-vous contre la secousse électrique:

   a. Les circuits à l'électrode et à la piéce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vétements mouillés. Porter des gants secs et sans trous pour isoler les mains.
   b. Faire trés attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher metallique ou des grilles metalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
   c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état defonctionnement.
   d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
   e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
   f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces precautions pour le porte-électrode s'applicuent aussi au pistolet de soudage.

2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas ou on recoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.

3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:

   a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
   b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
   c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.

4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.

5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans lateraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.

7. Quand on ne soude pas, poser la pince à une endroit isolé de la masse. Un court-circuit accidental peut provoquer un échauffement et un risque d'incendie.

8. S'assurer que la masse est connectée le plus prés possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaines de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'echauffement des chaines et des câbles jusqu'à ce qu'ils se rompent.

9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particuliérement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumeés toxiques.

10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgéne (gas fortement toxique) ou autres produits irritants.

11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le chassis du poste conformement au code de l'électricité et aux recommendations du fabricant. Le dispositif de montage ou la piece à souder doit être branché à une bonne mise à la terre.

2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.

3. Avant de faires des travaux à l'interieur de poste, la debrancher à l'interrupteur à la boite de fusibles.

4. Garder tous les couvercles et dispositifs de sûreté à leur place.

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INSTALLATION

TECHNICAL SPECIFICATIONS - RANGER 250 (K1725-1/K1725-2)

INPUT - GASOLINE ENGINE

Make/Model	Description	Speed (RPM)	Displacement cu. in. (cu. cm.)	Starting System	Capacities
Onan P216 (K1725-1)	2 cylinder	High Idle 3700	44 (714) - Onan 38 (624) - Kohler	12 VDC Battery & Starter	Fuel: 12 gal. 45.4 L
	16 HP @ 3600 RPM (Onan)		Bore x Stroke inch (mm)	(Group 58; 435 cold crank amps)	Oil: 1.8 Qts. 1.7 L (Onan)
Kohler CH20 (K1725-2)	20 HP @ 3600 RPM (Kohler)	Full Load 3500	3.25 x 2.625 (83 x 67) (Onan)	Battery Charger 20 A. regulated (K1725-1) 15 A. regulated (K1725-2)	Oil: 2.0 Qts. 1.9 L (Kohler)
		Low Idle 2400	3.03 x 2.64 (77 x 67) (Kohler)	(Push Button Start)	Cooling System: Air-Cooled

RATED OUTPUT - WELDER

Welding Output	Volts at Rated Amps	Duty Cycle Max.	OCV @ 3700 RPM
CC STICK & PIPE DC Output	25 Volts at 250 Amps	100%	
STICK / PIPE Output Range	20 to 250 Amps		
TIG Output Range	20 to 250 Amps		80 Volts
CV WIRE DC Output	25 Volts at 250 Amps	100%	
CV WIRE Output Range	14 to 28 Volts		

OUTPUT - GENERATOR

Auxiliary Power[1]

8,000 Watts, 60 Hz
120/240 Volts
100% Duty Cycle

PHYSICAL DIMENSIONS

Height	Width	Depth	Weight
30.00* in. 762.0 mm	21.50 in. 546.0 mm	42.25 in. 1073.0 mm	452 lbs. (205 kg.) K1725-1 434 lbs. (197 kg.) K1725-2

* Top of enclosure, add 6.0" (152 mm) for exhaust

ENGINE COMPONENTS

Lubrication	Valve Lifters	Fuel System	Governor
Full Pressure with Full Flow Filter	Solid (Onan) Hydraulic (Kohler)	Vacuum Pulse Pump (Onan) Mechanical Fuel Pump (Kohler)	Mechanical Governor 5% Regulation

Air Cleaner	Engine Idler	Muffler	Engine Protection
Duel Element	Automatic Idler	Low noise muffler: Top outlet can be rotated. Made from long life, aluminized steel.	Shutdown on low oil pressure.

Receptacles	Auxiliary Power Circuit Breaker	Other Circuit Breakers
Two 120 VAC Duplex (5-20R) One 120/240 VAC Dual Voltage Full KVA (14-50R)	Two 20 Amp for Two Duplex Receptacle Two 35 Amp for Dual Voltage	25 Amp for Battery Charging Circuit 150 Amp for 42 Volt Wire Feeder Power

1. Output rating in watts is equivalent to volt-amperes at unity power factor. Output voltage is within ± 10% at all loads up to rated capacity. When welding, available auxiliary power will be reduced.

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INSTALLATION

Read this entire installation section before you start installation.

SAFETY PRECAUTIONS

⚠ WARNING

Do not attempt to use this equipment until you have thoroughly read the engine manufacturer's manual supplied with your welder. It includes important safety precautions, detailed engine starting, operating and maintenance instructions and parts lists.

ELECTRIC SHOCK can kill.
- Do not touch electrically live parts or electrode with skin or wet clothing.
- Insulate yourself from work and ground.
- Always wear dry insulating gloves.

ENGINE EXHAUST can kill.
- Use in open, well ventilated areas or vent exhaust outside.
- Do not stack anything near the engine.

MOVING PARTS can injure.
- Do not operate with doors open or guards off.
- Stop engine before servicing.
- Keep away from moving parts.

See additional safety information at the front of this manual.

Only qualified personnel should install, use, or service this equipment.

LOCATION AND VENTILATION

The welder should be located to provide an unrestricted flow of clean, cool air to the cooling air inlets and to avoid restricting the cooling air outlets. Also, locate the welder so that the engine exhaust fumes are properly vented to an outside area.

STORING

1. Store the machine in a cool, dry place when it is not in use. Protect it from dust and dirt. Keep it where it can't be accidentally damaged from construction activities, moving vehicles, and other hazards.
2. If you will be storing the machine for over 30 days, you should drain the fuel to protect fuel system and carburetor parts from gum deposits. Empty all fuel from the tank and run the engine until it stops from lack of fuel. If you prefer, you can treat the gasoline with a stabilizer to prevent deterioration rather than drain the system. Follow the stabilizer manufacturer's instructions. Add the correct amount of stabilizer for the size of the fuel tank. Fill the tank with clean, fresh gasoline. Run the engine for two to three minutes to circulate the stabilizer through the carburetor.
3. While the engine is still warm, drain the oil and refill with fresh 10W30 oil. Change the oil filter.
4. Remove the spark plugs and add one to two tablespoons of engine oil or rust inhibitor into each cylinder. Replace the spark plugs but do not connect the plug leads. Crank the engine two or three times to distribute the oil.
5. Clean any dirt or debris from the cylinder and cylinder head fins and other exterior surfaces.

STACKING

Ranger 250 machines CANNOT be stacked.

ANGLE OF OPERATION

Engines are designed to run in the level condition, which is where the optimum performance is achieved. The maximum angle of continuous operation is 15 degrees in any direction. If the engine is to be operated at an angle, provisions must be made for checking and maintaining the oil level at the normal (FULL) oil capacity in the crankcase.

When operating the welder at an angle, the effective fuel capacity will be slightly less than the specified 12 gallons (45.4 liters).

LIFTING

The Ranger 250 weighs approximately 452 lbs./205 kg. with a full tank of gasoline. A lift bail is mounted to the machine and should always be used when lifting it.

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ADDITIONAL SAFETY PRECAUTIONS

⚠ WARNING

FALLING EQUIPMENT can cause injury.

- Do not lift this machine using lift bail if it is equipped with a heavy accessory such as trailer or gas cylinder.
- Lift only with equipment of adequate lifting capacity.
- Be sure machine is stable when lifting.

HIGH ALTITUDE OPERATION

At higher altitudes, output de-rating may be necessary. For maximum rating, de-rate the welder output 3.5% for every 1000 ft. (305m). Contact an authorized engine service shop for modifications to operate above 5,000 ft. (1525m).

HIGH TEMPERATURE OPERATION

At temperatures above 30°C, output de-rating is necessary. For maximum output ratings, de-rate the welder output 5% for every 10°C above 30°C.

TOWING

The recommended trailer for use with this equipment for road, in-plant and yard towing by a vehicle[1] is Lincoln's K957-1. If the user adapts a non-Lincoln trailer, he must assume responsibility that the method of attachment and usage does not result in a safety hazard nor damage the welding equipment. Some of the factors to be considered are as follows:

1. Design capacity of trailer vs. weight of Lincoln equipment and likely additional attachments.
2. Proper support of, and attachment to, the base of the welding equipment so there will be no undue stress to the framework.
3. Proper placement of the equipment on the trailer to insure stability side to side and front to back when being moved and when standing by itself while being operated or serviced.
4. Typical conditions of use such as travel speed, roughness of surface on which the trailer will be operated, environmental conditions, and likely maintenance.
5. Conformance with federal, state and local laws.[1]

[1] Consult applicable federal, state and local laws regarding specific requirements for use on public highways.

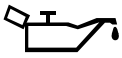
PRE-OPERATION ENGINE SERVICE

Read and understand the information about the gasoline engine in the ***Operation*** and ***Maintenance*** sections of this manual before you operate the Ranger 250.

⚠ WARNING

- Keep hands away from the engine muffler or HOT engine parts.
- Stop the engine and allow it to cool before fueling.
- Do not smoke when fueling.
- Fill the fuel tank at a moderate rate and do not overfill.
- Wipe up spilled fuel and allow the fumes to clear before starting the engine.
- Keep sparks and flame away from the fuel tank.
- Remove the fuel cap slowly to release pressure.

OIL



The Ranger 250 is shipped with the engine crankcase filled with high quality SAE 10W-30 oil (API class CD or better). **CHECK THE OIL LEVEL BEFORE YOU START THE ENGINE.** If it is not up to the FULL mark on the dipstick, add oil as required. Check the oil every four hours of running time during the first 25 running hours. Refer to the engine operator's manual for specific oil recommendations and break-in information. The oil change interval is dependent on the quality of the oil and the operating environment. Refer to the engine operator's manual for the proper service and maintenance intervals.

FUEL

Use gasoline fuel only.
Fill the fuel tank with clean, fresh fuel. The capacity of the fuel tank is 12 gallons (45.4 liters).

NOTE: The fuel tank is mounted below the engine, so a fuel shutoff valve is not required.

ENGINE COOLING SYSTEM

Air to cool the engine is drawn in through the lower set of louvers on the case back. It is important that the intake air is not restricted. Allow a minimum clearance of 2 feet (0.6m) from the case back to a vertical surface.

BATTERY CONNECTIONS

⚠ WARNING

BATTERY ACID CAN BURN EYES AND SKIN.

- Wear gloves and eye protection and be careful when working near a battery. Follow the instructions printed on the battery.

Use caution as the electrolyte is a strong acid that can burn skin and damage eyes.

The Ranger 250 is shipped with the negative battery cable disconnected. Make certain that the RUN-STOP switch is in the STOP position. Remove the screws from the rear battery tray using a screwdriver or a 3/8" socket. Attach the negative battery cable to the negative battery terminal and tighten using a socket or wrench.

NOTE: This machine is furnished with a wet charged battery; if unused for several months, the battery may require a booster charge. Be careful to charge the battery with the correct polarity. See the battery charging instructions in the ***Maintenance*** section.

MUFFLER OUTLET PIPE

Using the clamp provided, secure the outlet pipe to the outlet tube with the pipe positioned to direct the exhaust in the desired direction. Tighten using a socket or wrench.

SPARK ARRESTER

Some federal, state or local laws may require spark arresters in locations where unarrested sparks may present a fire hazard. The standard muffler included with this welder does not qualify as a spark arrester. When required by local regulations, a suitable spark arrester, such as the S24647, must be installed and properly maintained. See the ***Accessories*** section for more information.

⚠ CAUTION

An incorrect spark arrester may lead to engine damage or may adversely affect performance.

HIGH FREQUENCY GENERATORS FOR TIG APPLICATIONS

The K930-2 TIG Module is suitable for use with the Ranger 250. The Ranger 250 and any high frequency generating equipment must be properly grounded. See the K930-2 operating manual for complete instructions on installation, operation, and maintenance.

REMOTE CONTROL

The Ranger 250 is equipped with a 6-pin and a 14-pin Amphenol connector. The 6-pin connector is for connecting the K857 or K857-1 Remote Control (optional) or for TIG welding, the K870 foot Amptrol or the K963-2 hand Amptrol.

When in the CC-STICK, PIPE, and CV-WIRE modes and when a remote control is connected to the Amphenol, the auto-sensing circuit in the Ranger 250 automatically switches the OUTPUT control from control at the welder to remote control.

The 14-pin connector is used to directly connect a wire feeder. In the CV-WIRE mode, the Ranger 250 auto-sensing circuit automatically makes the Ranger 250 OUTPUT control inactive and the wire feeder voltage control active when the control cable is connected to the 14-pin connector.

NOTE: When a wire feeder with a built in welding voltage control is connected to the 14-pin connector, do NOT connect anything to the 6-pin connector.

WELDING TERMINALS

The Ranger 250 is equipped with a toggle switch for selecting “hot” welding terminals when in the “WELD TERMINALS ON” position or “cold” welding terminals when in the “REMOTELY CONTROLLED” position.

ELECTRICAL OUTPUT CONNECTIONS

See Figure A.1 for the location of the 120 and 240 volt receptacles, weld output terminals, and ground stud.

MACHINE GROUNDING

Because this portable engine driven welder creates its own power, it is not necessary to connect its frame to an earth ground, unless the machine is connected to premises wiring (home, shop, etc.)

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To prevent dangerous electric shock, other equipment to which this engine driven welder supplies power must:

a) Be grounded to the frame of the welder using a grounded type plug.

b) Be double insulated.

⚠ WARNING

Do not ground the machine to a pipe that carries explosive or combustible material.

When this welder is mounted on a truck or trailer, its frame must be securely connected to the metal frame of the vehicle. When connected to premises wiring such as that in a home or shop, the welder frame must be connected to the system earth ground. See further connection instructions in the section entitled ***Standby Power Connections*** as well as the article on grounding in the latest U.S. National Electrical Code and the local code.

In general, if the machine is to be grounded, it should be connected with a #8 or larger copper wire to a solid earth ground such as a metal water pipe going into the ground for at least ten feet and having no insulated joints, or to the metal framework of a building which has been effectively grounded. The U.S. National Electrical Code lists a number of alternate means of grounding electrical equipment. A machine grounding stud marked with the ⏚ ground symbol is provided on the front of the welder.

WELDING OUTPUT CABLES

With the engine off, connect the electrode and work cables to the output terminals. The welding process dictates the polarity of the electrode cable. These connections should be checked periodically and tightened with a wrench.

Table A.1 lists recommended cable sizes and lengths for rated current and duty cycle. Length refers to the distance from the welder to the work and back to the welder. Cable diameters are increased for long cable lengths to reduce voltage drops. Avoid coiling long cables on the machine when welding.

FIGURE A.1 – RANGER 250 OUTPUT CONNECTIONS

1. 120 VAC RECEPTACLES
2. 120/240 VAC RECEPTACLES
3. WELD OUTPUT TERMINALS
4. GROUND STUD

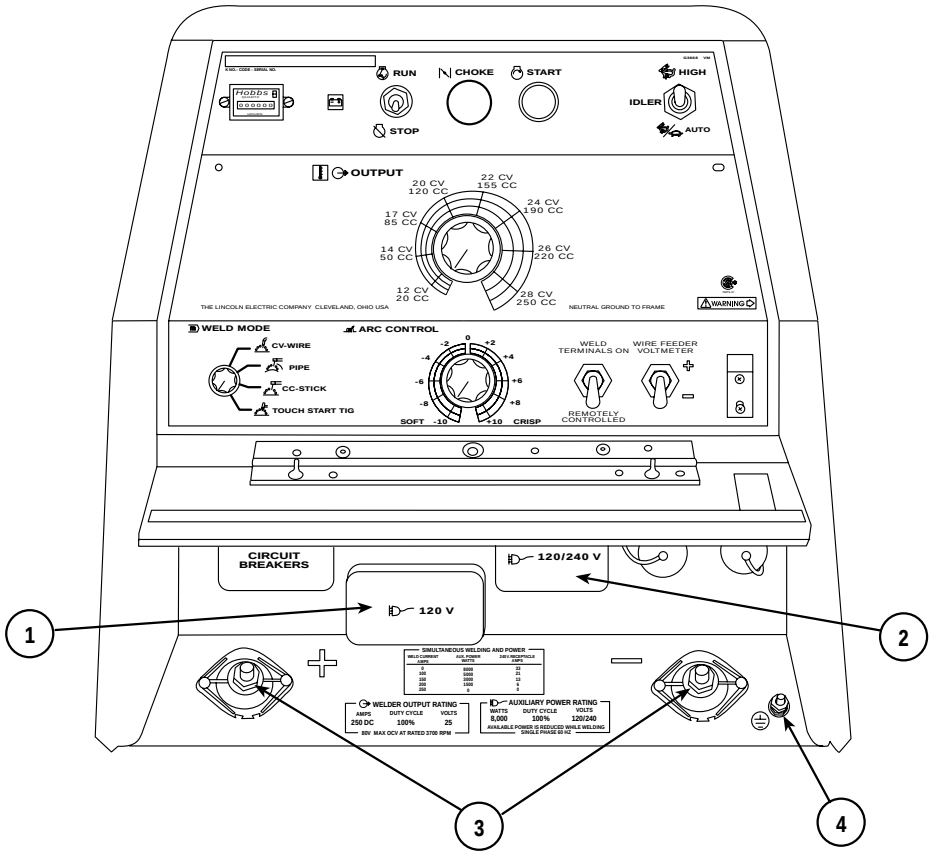

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TABLE A.1 – TOTAL COMBINED LENGTH OF ELECTRODE AND WORK CABLES

Cable Length	Cable Size for 250 Amps 100% Duty Cycle
0-100 ft. (0-30 meters)	1 AWG
100-200 ft. (30-46 meters)	1 AWG
150-200 ft. (46-61 meters)	1/0 AWG

CABLE INSTALLATION

Install the welding cables to your Ranger 250 as follows.

1. The engine must be OFF to install welding cables.
2. Remove the flanged nuts from the output terminals.
3. Connect the electrode holder and work cables to the weld output terminals. The terminals are identified on the case front.
4. Tighten the flanged nuts securely.
5. Be certain that the metal piece you are welding (the "work") is properly connected to the work clamp and cable.
6. Check and tighten the connections periodically.

⚠ CAUTION

- Loose connections will cause the output terminals to overheat. The terminals may eventually melt.
- Do not cross the welding cables at the output terminal connection. Keep the cables isolated and separate from one another.

AUXILIARY POWER RECEPTACLES

The auxiliary power of the Ranger 250 consists of two 20 amp-120 VAC (5-20R) duplex receptacles and one 50 amp 120/240 VAC (14-50R) receptacle. The 240 VAC receptacle can be split for single-phase 120 VAC operation.

The auxiliary power capacity is 8,000 watts of 60 Hz, single-phase power. The auxiliary power capacity rating in watts is equivalent to volt-amperes at unity power factor. The maximum permissible current of the 240 VAC output is 33 amps. The 240 VAC output can be split to provide two separate 120 VAC outputs with a maximum permissible current of 33 amps per output to two separate 120 VAC branch circuits (these circuits cannot be paralleled). Output voltage is within ±10% at all loads up to rated capacity.

The 120 VAC auxiliary power receptacles should only be used with three-wire grounded type plugs or approved double insulated tools with two-wire plugs. The current rating of any plug used with the system must be at least equal to the current capacity of the associated receptacle.

NOTE: The 240 VAC receptacle has two 120 VAC circuits, but they are of opposite polarities and cannot be paralleled.

STANDBY POWER CONNECTIONS

The Ranger 250 is suitable for temporary, standby or emergency power using the engine manufacturer's recommended maintenance schedule.

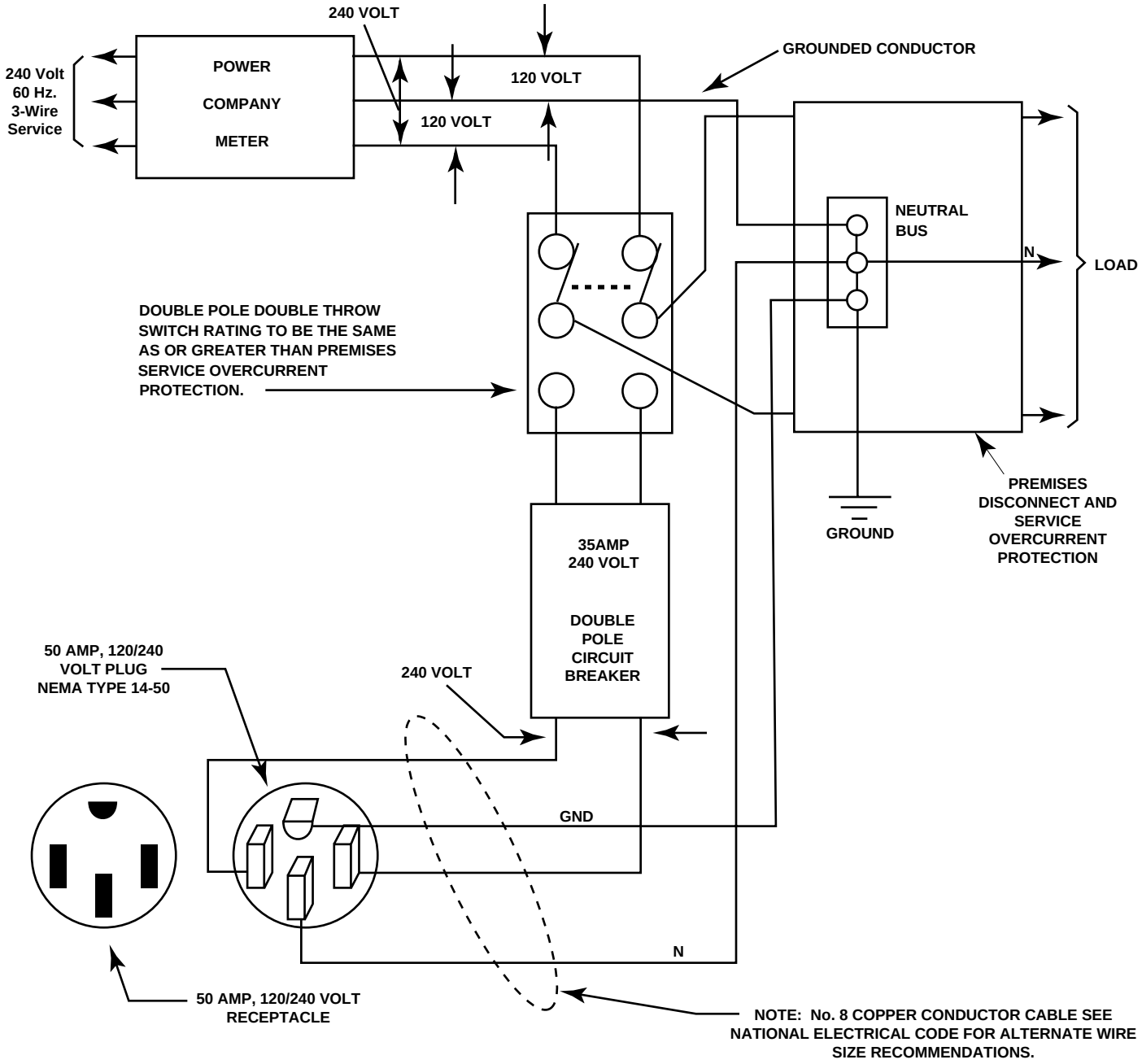
The Ranger 250 can be permanently installed as a standby power unit for 240 VAC, three-wire, single-phase, 35 amp service. Connections must be made by a licensed electrician who can determine how the 120/240 VAC power can be adapted to the particular installation and comply with all applicable electrical codes. The following information can be used as a guide by the electrician for most applications. Refer to the connection diagram in ***Figure A-2.***

1. Install the double-pole, double-throw switch between the power company meter and the premises disconnect. Switch rating must be the same or greater than the customer's premises disconnect and service over current protection.
2. Take necessary steps to assure load is limited to the capacity of the Ranger 250 by installing a 35 amp, 240 VAC double-pole circuit breaker.

   Maximum rated load for each leg of the 240 VAC auxiliary is 33 amperes. Loading above the rated output will reduce output voltage below the allowable ±10% of rated voltage, which may damage appliances or other motor-driven equipment and may result in overheating of the Ranger 250 engine and/or alternator windings.
3. Install a 50 amp, 120/240 VAC plug (NEMA Type 14-50) to the double-pole circuit breaker using No. 6, 4-conductor cable of the desired length. (The 50 amp, 120/240 VAC plug is available in the optional K802R plug kit or as part number T12153-9.)
4. Plug this cable into the 50 amp, 120/240 VAC receptacle on the Ranger 250 case front.

INSTALLATION

FIGURE A.2 – CONNECTION OF THE RANGER 250 TO PREMISES WIRING



⚠ WARNING

- **Only a licensed, certified, trained electrician should install the machine to a premises or residential electrical system. Be certain that:**
- **The installation complies with the National Electrical Code and all other applicable electrical codes.**
- **The premises is isolated and no feedback into the utility system can occur. Certain state and local laws require the premises to be isolated before the generator is linked to the premises. Check your state and local requirements.**
- **A double-pole, double-throw transfer switch in conjunction with the properly rated double-throw circuit breaker is connected between the generator power and the utility meter.**

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OPERATING INSTRUCTIONS

Read and understand this entire section before operating your Ranger 250.

SAFETY INSTRUCTIONS

⚠ WARNING

Do not attempt to use this equipment until you have thoroughly read all the operating and maintenance manuals supplied with your machine. They include important safety precautions; detailed engine starting, operating and maintenance instructions and parts lists.

ELECTRIC SHOCK can kill.

- Do not touch electrically live parts such as output terminals or internal wiring.
- Insulate yourself from the work and ground.
- Always wear dry insulating gloves.

FUMES AND GASES can be dangerous.

- Keep your head out of fumes.
- Use ventilation or exhaust to remove fumes from breathing zone.

WELDING SPARKS can cause fire or explosion.

- Keep flammable material away.
- Do not weld on containers that have held combustibles.

ARC RAYS can burn.

- Wear eye, ear, and body protection.

⚠ WARNING

ENGINE EXHAUST can kill.

- Use in open, well ventilated areas or vent exhaust to the outside.
- Do not stack anything on or near the engine.

MOVING PARTS can injure.

- Do not operate this equipment with any of its doors open or guards off.
- Stop the engine before servicing it.
- Keep away from moving parts.

Only qualified personnel should install, use, or service this equipment.

ADDITIONAL SAFETY PRECAUTIONS

Always operate the welder with the hinged door closed and the side panels in place. These provide maximum protection from moving parts and insure proper cooling air flow.

GENERAL DESCRIPTION

The Ranger 250 is a gasoline-engine-powered DC multi-process welding power source and 120 / 240 VAC power generator. The engine drives a generator that supplies three-phase power for the DC welding circuit and single-phase power for the AC auxiliary outlets. The DC welding control system uses state of the art ***Chopper Technology*** (CT™) for superior welding performance.

DESIGN FEATURES

- Single, full-range output control dial.
- 4 welding modes: CC-stick, downhill stick welding on pipe, CV wire welding and Touch-Start TIG™ (eliminates high frequency and tungsten contamination).
- Output at welding terminals controlled by electronic contactor. Can be switched to “On”, or to “Remotely Controlled”. Contactor auto-activated when connected. 6-pin connector for remote output.
- Many wire feeder combinations: 14-pin connector for Lincoln wire feeders LN-25, LN-23P, LN-7, LN-8 operates when using a Lincoln wire feeder with the appropriate control cable.
- Smart machine! Remote operation and Magnum® spool gun; 42VAC for LN-742 and Cobramatic® wire feeders.
- Wire feed voltmeter switch matches polarity of wire feeder voltmeter to polarity of electrode.
- 12 gallon fuel capacity allows you to run an extended day.
- Easily check fuel level during operation and refuelling with highly visible fuel gauge located next to the fuel cap on case top side.
- Longer engine life, reduced noise emissions and greater fuel economy with the automatic engine idler.
- Conveniently located engine maintenance label under top engine door.
- Engine hour meter for scheduled maintenance.
- Automatic engine shutdown protection for low oil pressure.
- Electric start. Reduce abnormal charging thanks to a backlit battery charger system light indicator.
- Oil drain valve (no tools required).
- 8,000 watts of continuous duty AC generator power.
- Up to 33 amps at 240V from the 120V/240V receptacle. Circuit breaker protection.
- Two 120V 20A duplex receptacles. Circuit breaker protection. Will operate up to a 9” grinder.

CONTROLS AND SETTINGS

The gasoline engine stop/start and idler controls are located on the case front panel. The welder controls are also located here. See ***Figure B.1.***

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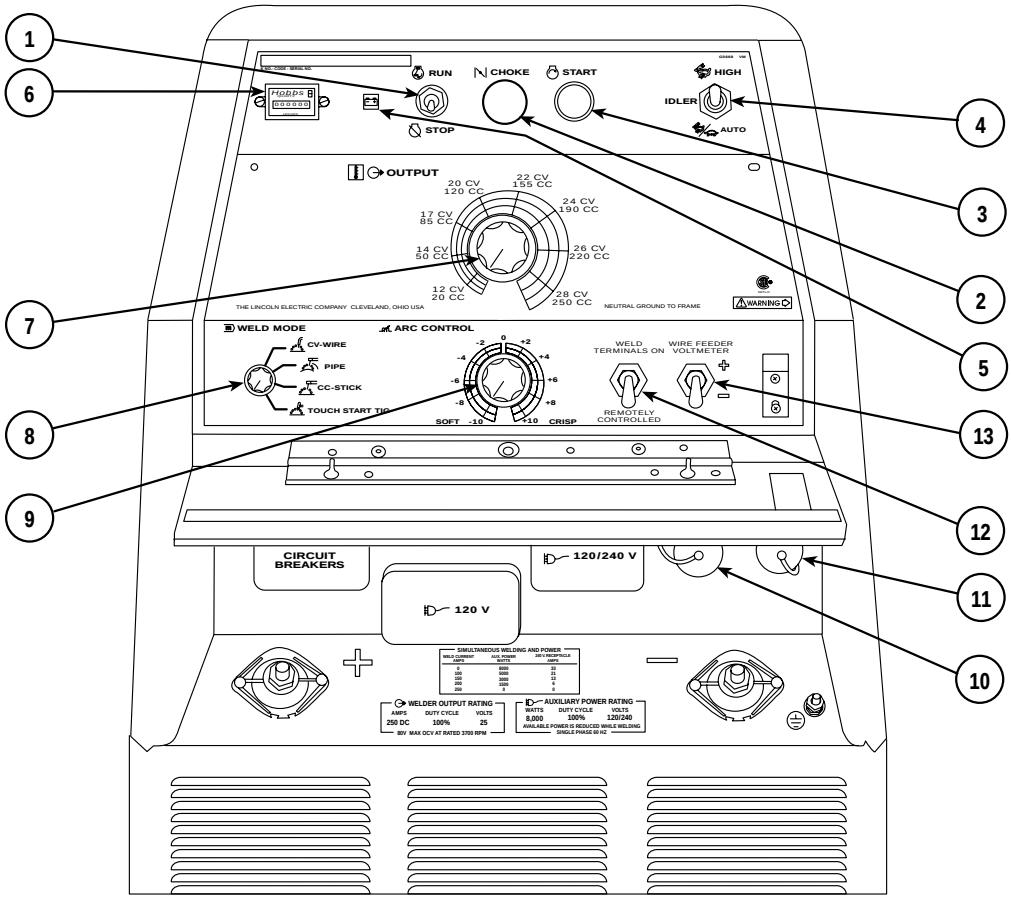
OPERATION

FIGURE B.1 – CASE FRONT PANEL CONTROLS



ENGINE CONTROLS

1. **RUN/STOP SWITCH:** RUN position energizes the engine prior to starting. STOP position stops the engine. The oil pressure interlock switch prevents battery drain if the switch is left in the RUN position and the engine is not operating.
2. **CHOKE:** When pulled out, it closes the choke valve on the engine carburetor for quick starting.
3. **START PUSHBUTTON:** Energizes the starter motor to crank the engine.
4. **IDLER SWITCH:** Has two positions as follows:

   A) In the HIGH position, the engine runs at the high idle speed controlled by the engine governor.

   B) In the AUTO position, the idler operates as follows:

   a. When switched from HIGH to AUTO or after starting the engine, the engine will operate at high speed for approximately 12 seconds and then go to low idle speed.

   b. When the electrode touches the work or power is drawn from the auxiliary power receptacles (approximately 100 watts minimum), the engine accelerates and operates at high speed.

   c. When welding ceases or the AC power load is turned off, a fixed time delay of approximately 12 seconds starts. If the welding or AC power load is not restarted before the end of the time delay, the idler reduces the engine speed to low idle speed.

   d. The engine will automatically return to high idle speed when the welding load or AC power load is reapplied.

5. **ENGINE ALTERNATOR TROUBLE LIGHT:** The yellow engine alternator light is off when the battery charging system is functioning normally. If the light turns on, the alternator or the voltage regulator may not be operating correctly. The light may also come on if the battery is not holding a charge. It is normal for the light to come on while starting the engine.
6. **ENGINE HOUR METER:** Displays the total time that the engine has been running. This meter is useful for scheduling prescribed maintenance.

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WELDING CONTROLS

7. **OUTPUT CONTROL:** The OUTPUT dial provides continuous control of the welding current or welding voltage depending on the selected welding mode. This control is not active in the CC-STICK, PIPE, and CV-WIRE modes when a remote control or wire feeder with remote control is connected to either the 6-pin or 14-pin Amphenol.

8. **WELD MODE SELECTOR SWITCH:** This switch provides four selectable welding modes:

   - CV-WIRE
   - PIPE
   - CC-STICK
   - TOUCH START TIG

9. **ARC CONTROL:** The ARC CONTROL WIRE/STICK dial is active in the CV-WIRE and CC-STICK modes, and has different functions in these modes. This control is not active in the TIG and PIPE modes.

   CC-STICK mode: In this mode, the ARC CONTROL sets the short circuit current during stick welding (arc-force). Increasing the number from -10 to +10 increases the short circuit current and prevents sticking of the electrode to the plate while welding. This can also increase spatter. It is recommended that the ARC CONTROL be set to the minimum number without electrode sticking. Start with a setting at 0.

   CV-WIRE mode: In this mode, turning the ARC CONTROL clockwise from -10 (soft) to +10 (crisp) changes the arc from soft and washed-in to crisp and narrow. It acts as an inductance control. The proper setting depends on the procedure and operator preference. Start with a setting at 0.

10. **14-PIN AMPHENOL:** For attaching wire feeder control cables to the Ranger 250. Includes contactor closure circuit, auto-sensing remote control circuit, and 120V and 42V power. The remote control circuit operates the same as the 6-pin Amphenol. See below.

11. **6-PIN AMPHENOL:** For attaching optional remote control equipment. When in the CC-STICK, PIPE, and CV-WIRE modes and when a remote control is connected to the Amphenol, the auto-sensing circuit in the Ranger 250 automatically switches the OUTPUT control from control at the welder to remote control.

    When using the TOUCH START TIG mode, the OUTPUT control on the front of the Ranger 250 sets the maximum current range.

12. **WELD TERMINALS CONTROL SWITCH:** In the WELD TERMINALS ON position, the weld output is electrically hot all the time. In the REMOTELY CONTROLLED position, the weld output is controlled by a wire feeder or amptrol device, and is electrically off until a remote switch is depressed.

13. **WIRE FEEDER VOLTMETER SWITCH:** Matches the polarity of the wire feeder voltmeter to the polarity of the electrode.

ENGINE OPERATION

⚠ WARNING

DO NOT RUN THE ENGINE AT EXCESSIVE SPEEDS. The maximum allowable high idle speed for the Ranger 250 is 3750 RPM, no load. Do NOT adjust the governor screw on the engine. Severe personal injury and damage to the machine can result if it is operated at speeds above the maximum rated speed.

Read and understand all safety instructions included in the engine operator's manual that is shipped with your Ranger 250.

BEFORE STARTING THE ENGINE

Check and fill the engine oil level:

1. Be sure the machine is on a level surface.
2. Open top engine door and remove the engine oil dipstick and wipe it with a clean cloth. Reinsert the dipstick and check the level on the dipstick.
3. Add oil (if necessary) to bring the level up to the full mark. Do not overfill. Close engine door.
4. See the ***Maintenance*** section for specific oil recommendations.

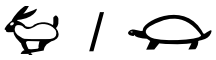
Check and fill the engine fuel tank:

⚠ WARNING

GASOLINE can cause fire or explosion.
- Stop engine when fueling.
- Do not smoke when fueling.
- Do not overfill tank.
- Avoid contact with skin or breathing of vapor.
- Keep sparks and flame away from tank.

1. Remove the fuel tank cap.
2. Fill the tank approximately 4 inches (100mm) from the top of the filler neck to allow for fuel expansion. (Observe the fuel gauge while filling.) DO NOT FILL THE TANK TO THE POINT OF OVERFLOW.
3. Replace the fuel cap and tighten securely.
4. See the ***Maintenance*** section for specific fuel recommendations.

STARTING THE ENGINE

1. Remove all plugs connected to the AC power receptacles.
2. Set the IDLER switch to AUTO. 
3. Set the RUN/STOP switch to RUN.
4. Pull the choke to the full out position.
5. Press and hold the engine START button until the engine starts.
6. Release the engine START button when the engine starts.
7. Push the choke back in.
8. The engine will run at high idle speed for approximately 12 seconds and then go to low idle speed. Allow the engine to warm up at low idle for several minutes before applying a load and/or switching to high idle. Allow a longer warm up time in cold weather.

⚠ CAUTION

Operating the starter motor for more than 5 seconds can damage the motor. If the engine fails to start, release the START button and wait 10 seconds before activating the starter again. Do NOT push the START button while the engine is running because this can damage the ring gear and/or the starter motor.

NOTE: Starting a Ranger 250 for the first time, or after an extended period of time of not operating, will take longer than normal. The fuel pump has to fill the fuel line and carburetor. If the engine will not start, see the ***Troubleshooting*** section of this manual.

STOPPING THE ENGINE

1. Remove all welding and auxiliary power loads and allow the engine to run at low idle speed for a few minutes to cool the engine.
2. Stop the engine by placing the RUN-STOP switch in the STOP position.

NOTE: A fuel shut off valve is not required on the Ranger 250 because the fuel tank is mounted below the engine.

BREAK-IN PERIOD

Any engine will use a small amount of oil during its “break-in” period. For the gasoline engine on the Ranger 250, break-in is about 50 running hours.

Check the oil at least twice a day during break-in. Change the oil after the first 25 hours of operation. Change the oil filter at the second oil change. For more details, see the ***Maintenance*** section of this manual.

⚠ CAUTION

During break-in, subject the Ranger 250 to moderate loads. Avoid long periods running at idle. Before stopping the engine, remove all loads and allow the engine to cool several minutes.

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WELDER OPERATION

GENERAL INFORMATION

⚠ WARNING

- Do not touch electrically live parts or electrodes with your skin or wet clothing.

- Do not breathe welding fumes or gases.
- Use ventilation or exhaust to remove welding from the breathing area.

- Keep flammable material away.
- Wear eye, ear, and body protection.

The Ranger 250 can deliver from 40 to 250 amps of constant current for DC stick welding or from 20 to 250 amps of constant voltage current for DC semiautomatic wire feed welding. DC TIG welding is possible across the entire range from 20 to maximum rated output. Output can be adjusted by setting the OUTPUT control dial and the ARC control dial on the output control panel to the settings that are best for your selected welding process.

NOTE: An unstable or unsatisfactory welding arc can result if welding cables are too long or are coiled on the machine when welding. See ***Table A.1*** in the ***Installation*** section. **Straighten out coiled cables before welding.**

TABLE B.1 – TYPICAL RANGER 250 FUEL CONSUMPTION

	Onan P216 16 hp @ 3600 rpm gal./hr (liters/hr)	Kohler CH20 12 gallons-hours gal./hr (liters/hr)	Running Time for 12 gallons-hours Onan/Kohler
Low Idle - No Load 2400 R.P.M.	0.6 (2.3)	0.6 (2.3)	20/20
High Idle - No Load 3700 R.P.M.	0.8 (3.0)	0.8 (3.0)	15/15
DC Weld Output 250 Amps @ 25 Volts	1.7 (6.4)	1.4 (5.3)	7.0/8.6
Auxiliary Power 8,000 Watts	1.8 (6.8)	1.4 (5.3)	6.4/8.6

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STICK WELDING

The Ranger 250 can be used with a broad range of DC stick electrodes.

The MODE switch provides two stick welding settings as follows:

CONSTANT CURRENT (CC-STICK) WELDING

The CC-STICK position of the MODE switch is designed for horizontal and vertical-up welding with all types of electrodes, especially low hydrogen. The OUTPUT control adjusts the full output range for stick welding.

The ARC control sets the short circuit current during stick welding (arc-force). Increasing the number from -10 to +10 increases the short circuit current and prevents sticking of the electrode to the plate while welding. This can also increase spatter. It is recommended that the ARC control be set to the minimum number without electrode sticking. Start with the dial set at 0.

PIPE WELDING

This slope-controlled setting is intended for "out-of-position" and "downhill" pipe welding where the operator would like to control the current level by changing the arc length. The OUTPUT control dial adjusts the full output range for pipe welding. The ARC control is not active in the PIPE mode.

TABLE B.2 – TYPICAL CURRENT RANGES[1] FOR TUNGSTEN ELECTRODES[2]

Tungsten Electrode Diameter in. (mm)	DCEN (-)	DCEP (+)	Approximate Argon Gas Flow Rate C.F.H. (l/min.)		TIG TORCH Nozzle Size [4, 5]
	1%, 2% Thoriated Tungsten	1%, 2% Thoriated Tungsten	Aluminum	Stainless Steel	
0 .010 (.25)	2-15	[3]	3-8 (2-4)	3-8 (2-4)	#4, #5, #6
0.020 (.50)	5-20	[3]	5-10 (3-5)	5-10 (3-5)	
0.040 (1.0)	15-80	[3]	5-10 (3-5)	5-10 (3-5)	
1/16 (1.6)	70-150	10-20	5-10 (3-5)	9-13 (4-6)	#5, #6
3/32 (2.4)	150-250	15-30	13-17 (6-8)	11-15 (5-7)	#6, #7, #8
1/8 (3.2)	250-400	25-40	15-23 (7-11)	11-15 (5-7)	
5/32 (4.0)	400-500	40-55	21-25 (10-12)	13-17 (6-8)	#8, #10
3/16 (4.8)	500-750	55-80	23-27 (11-13)	18-22 (8-10)	
1/4 (6.4)	750-1000	180-125	28-32 (13-15)	23-27 (11-13)	

[1] When used with argon gas. The current ranges shown must be reduced when using argon/helium or pure helium shielding gases.

[2] Tungsten electrodes are classified as follows by the American Welding Society (AWS):

Pure	EWP
1% Thoriated	EWTh-1
2% Thoriated	EWTh-2

Though not yet recognized by the AWS, Ceriated Tungsten is now widely accepted as a substitute for 2% Thoriated Tungsten in AC and DC applications.

[3] DCEP is not commonly used in these sizes.

[4] TIG torch nozzle "sizes" are in multiples of 1/16ths of an inch:

4 = 1/4 in. (6 mm)
5 = 5/16 in. (8 mm)
6 = 3/8 in. (10 mm)
7 = 7/16 in. (11 mm)
8 = 1/2 in. (12.5 mm)
#10 = 5/8 in. (16 mm)

[5] TIG torch nozzles are typically made from alumina ceramic. Special applications may require lava nozzles, which are less prone to breakage, but cannot withstand high temperatures and high duty cycles.

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TIG WELDING

The TOUCH START TIG setting of the MODE switch is for DC TIG (Tungsten Inert Gas) welding. To initiate a weld, the OUTPUT control is first set to the desired current and the tungsten is touched to the work. During the time the tungsten is touching the work there is very little voltage or current and, in general, no tungsten contamination. Then the tungsten is gently lifted off the work in a rocking motion, which establishes the arc.

The ARC CONTROL is not active in the TIG mode.

The Ranger 250 can be used in a wide variety of DC TIG welding applications. In general the “Touch Start” feature allows contamination-free starting without the use of a Hi-frequency unit. If desired, the K930-2 TIG Module can be used with the Ranger 250. The following settings are for reference.

Ranger 250 settings when using the K930-2 TIG Module with an Amptrol or Arc Start Switch:

a. Set the MODE Switch to the TOUCH START TIG setting.

b. Set the “IDLER” Switch to the “AUTO” position.

c. Set the "WELD TERMINALS” switch to the “REMOTELY CONTROLLED” position. This will keep the solid state contactor open and provide a “cold” electrode until the Amptrol or Arc Start switch is pressed.

When using the TIG Module, the OUTPUT control on the Ranger 250 is used to set the maximum range of the CURRENT.

WIRE WELDING-CV

Connect a wire feeder to the Ranger 250 according to the instructions in the ***Accessories*** section.

In the CV-WIRE mode, the Ranger 250 can be used with a broad range of flux cored wire (Innershield and Outershield) electrodes and solid wires for MIG welding (gas metal arc welding). Welding can be finely tuned using the ARC CONTROL. Turning the ARC CONTROL clockwise from -10 (soft) to +10 (crisp) changes the arc from soft and washed-in to crisp and narrow. It acts as an inductance control. The proper setting depends on the procedure and operator preference. Start with the dial set at 0.

Some recommended Innershield electrodes are: NR-311, NS-3M, NR-207, NR-203 Ni 1%, NR-204-H. Recommended Outershield electrodes are: 0S-70, 0S-71M.

Some recommended solid wires for MIG welding are: .035 (0.9 mm), and .045 (1.1 mm), L-50 and L-56, .035 (0.9 mm) and .045 (1.1 mm) Blue Max MIG 308 LS.

For any electrodes, including those above, the procedures should be kept within the rating of the machine.

ARC GOUGING

The Ranger 250 can be used for limited arc gouging. For optimal performance, set the MODE switch to CC-STICK and the ARC CONTROL to +10.

Set the OUTPUT CONTROL to adjust output current to the desired level for the gouging electrode being used according to the ratings in Table B.3.

TABLE B.3 – CURRENT RANGE PER ELECTRODE DIAMETER

Electrode Diameter	Current Range (DC, Electrode Positive)
1/8"	30-60 Amps
5/32"	90-150 Amps
3/16"	150-200 Amps

AUXILIARY POWER

⚠ WARNING

Be sure that any electrical equipment plugged into the generator AC power receptacles can withstand a ±10% voltage and a ±3% frequency variation.

Start the engine and set the IDLER control switch to the desired operating mode. Full power is available regardless of the welding control settings as long as no welding current is being drawn.

The auxiliary power of the Ranger 250 consists of two 20 amp-120 VAC (5-20R) duplex receptacles and one 50 amp 120/240 VAC (14-50R) receptacle. The 240 VAC receptacle can be split for single-phase 120 VAC operation.

The auxiliary power capacity is 8,000 watts of 60 Hz, single-phase power. The auxiliary power capacity rating in watts is equivalent to volt-amperes at unity power factor. The maximum permissible current of the 240 VAC output is 33 amps.

The 240 VAC output can be split to provide two separate 120 VAC outputs with a maximum permissible current of 33 amps per output to two separate 20 amp branch circuits. (These circuits cannot be paralleled.) Output voltage is within ±10% at all loads up to rated capacity.

The 120 VAC auxiliary power receptacles should only be used with three-wire, grounded type plugs or approved double-insulated tools with two-wire plugs. The current rating of any plug used with the system must be at least equal to the current capacity of the associated receptacle. For extension cord lengths, see Table B.5.

NOTE: The 240 VAC receptacle has two circuits, each of which measures 120 VAC to neutral. However, they are of opposite polarity and **cannot be paralleled.**

SIMULTANEOUS WELDING AND AUXILIARY POWER LOADS

The auxiliary power ratings are with no welding load. Simultaneous welding and power loads are specified in Table B.4. The permissible currents shown assume that current is being drawn from either the 120 VAC or 240 VAC supply (not both at the same time).

TABLE B.4 – RANGER 250 SIMULTANEOUS WELDING AND POWER LOADS

Welding Output- Amps	Permissible Power-Watts (Unity Power Factor)	Permissible Auxiliary Current in Amps	
		@ 120 VAC*	@ 240 VAC**
0	8000	40*	33
100	5000	40*	21
150	3000	25	12.5
200	1500	12.5	6.3
250	0	0	0

* Each duplex receptacle is limited to 20 amps.
** Not to exceed 25 amps per 120 VAC branch circuit when splitting the 240 VAC output.

TABLE B.5 – RANGER 250 EXTENSION CORD LENGTH RECOMMENDATIONS
(Use the shortest length extension cord possible sized per the following table)

Current Voltage		Load (Watts)	Maximum Allowable Cord Length in Ft. (m) for Conductor Size											
(Amps)	(Volts)		14 AWG		12 AWG		10 AWG		8 AWG		6 AWG		4 AWG	
15	120	1800	30	(9)	40	(12)	75	(23)	125	(38)	175	(53)	300	(91)
20	120	2400			30	(9)	50	(15)	88	(27)	138	(42)	225	(69)
15	240	3600	60	(18)	75	(23)	150	(46)	225	(69)	350	(107)	600	(183)
20	240	4800			60	(18)	100	(30)	175	(53)	275	(84)	450	(137)
33	240	8000					60	(18)	100	(30)	175	(53)	250	(76)
Conductor size is based on maximum 2.0% voltage drop.														

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OPTIONS/ACCESSORIES

FIELD INSTALLED OPTIONS

The following options/accessories are available for your Ranger 250 from your local Lincoln distributor.

K957-1 HEAVY DUTY, TWO-WHEEL TRAILER FOR SMALL WELDERS - For road, off-road and in-plant and yard towing. (For highway use, consult applicable federal, state and local laws regarding requirements for brakes, lights, fenders, etc.)

K1737-1 FOUR-WHEEL ALL-TERRAIN UNDERCARRIAGE - For moving by hand.

K1770-1 UNDERCARRIAGE (FACTORY) - For moving by hand on a smooth surface. One or two gas cylinders can be mounted on the rear of the undercarriage with the installation of K1745-1 Cylinder Holder(s).

K1739-1 CABLE CARRIER KIT - For use on K1737-1 and K1770-1 Undercarriages.

K1745-1 SINGLE GAS CYLINDER HOLDER - For use on K1770-1 Undercarriage. One or two may be installed on an undercarriage.

K1788-1 ROLL CAGE - Gives added damage protection.

K886-2 CANVAS COVER - Protects machine when not in use.

S24647 SPARK ARRESTER - Mounts inside exhaust pipe.

K702 ACCESSORY KIT - Accessory set includes 35 ft. (10.7 meters) 2 AWG electrode cable, 30 ft. (9.1 meters) 2 AWG work cable, headshield with No. 12 filter, GC300 work clamp and Cooltong 300 electrode holder. Cables are rated at 250 amps, 40% duty cycle.

K857 28 ft. (8.5m) or K857-1 100 ft. (30.4m) REMOTE CONTROL - Portable control provides same dial range as the output control on the welder. Has a convenient 6-pin plug for easy connection to the welder.

K1690-1 GFCI RECEPTACLE KIT - Includes one UL approved 120 volt ground fault circuit interrupter duplex type receptacle with cover and installation instructions. Replaces the factory installed 120V duplex receptacle. Each receptacle of the GFCI Duplex is rated at 20 amps. The maximum total current from the GFCI Duplex is limited to 20 amps. Two kits are required.

K802-N POWER PLUG KIT - Provides four 120 volt plugs rated at 20 amps each and one dual voltage, full KVA plug rated at 120/240 volts, 50 amps.

K802-R POWER PLUG KIT - Provides four 120 volt plugs rated at 15 amps each and one dual voltage, full KVA plug rated at 120/240 volts, 50 amps.

T12153-9 50 AMP, 120/240V POWER PLUG - Provides one dual voltage plug for full KVA power.

TIG WELDING ACCESSORIES

K1783-9 TIG TORCH - For TIG welding with shielding gas. Includes 25 feet of cable.

K963-2 - Hand Amptrol.

K870 - Foot Amptrol.

NOTE: TIG welding requires a Magnum™ TIG Gun, appropriate Magnum Parts Kit and argon gas.

SEMIAUTOMATIC FCAW AND MIG WELDING ACCESSORIES

LN-25 WIRE FEEDER K449 - This portable unit provides CC/CV for flux-cored arc welding (FCAW) and metal inert gas welding (MIG). Includes a gas solenoid and an internal contactor that allows across-the-arc operation with no control cable. The LN-25 provides a “cold” electrode until the gun trigger is pressed. For voltage control at the feeder, a K444-1 Remote Voltage Control Kit or K857 Remote Control is required. Refer to connection instructions later in this section.

LN-7 OR LN-8 WIRE FEEDER - Semiautomatic, constant speed wire feeders.

NOTE: Gas-shielded welding requires a Magnum Gun. Gasless welding requires an Innershield Gun.

LN-742 WIRE FEEDER - A semiautomatic wire feeder with “cold” electrode. Refer to connection instructions later in this section.

MAGNUM SPOOL GUN (K487-25) - A lightweight, semiautomatic wire feeder for aluminum welding with argon gas. Has built-in remote wire speed control in the handle. Requires the K488 SG Control Module. Refer to connection instructions later in this section.

SG CONTROL MODULE (K488) - Controls wire speed and gas flow. Provides the required control interface between the Ranger 250 and the K487-25 Magnum Spool Gun. Requires the K691-10 Input Cable.

K444-1 REMOTE VOLTAGE CONTROL - Provides voltage adjustment control at the feeder. Includes 25 feet of cable.

K126-2 INNERSHIELD GUN - For gasless welding. Includes 15 feet of cable.

K470-2 MAGNUM GUN CONNECTOR KIT - For gas-shielded welding.

K466-1 MAGNUM GUN CONNECTOR KIT - For connecting the Magnum 300 MIG Gun to the feeder for gas-shielded welding.

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CONNECTION OF LINCOLN ELECTRIC WIRE FEEDERS

⚠ WARNING

ELECTRIC SHOCK can kill.

- Do not operate with panels open.
- Disconnect NEGATIVE (-) BATTERY LEAD before servicing.
- Do not touch electrically live parts.

MOVING PARTS can injure.

- Keep guards in place.
- Keep away from moving parts.
- Only qualified personnel should install, use or service this equipment.

CONNECTION OF THE RANGER 250 TO WIRE FEEDERS USING K867 UNIVERSAL ADAPTER (SEE FIGURE C.1)

NOTE: When you use the Ranger 250 with non-Lincoln Electric wire feeders or with certain earlier models of Lincoln wire feeders, you will require the K867 Universal Adapter. The following discussion and connection diagram explain in general how to make the proper connections.

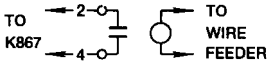
1. Shut the welder off.
2. Connect the electrode cable from the wire feeder to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

3. Connect the K867 Universal Adapter to the 14-pin amphenol of the Ranger 250 as shown in Figure C.1. Make the proper connections for local or remote control according to Figure C.1 and the following NOTES, indicated on the figure:

   A. These leads are not used for the Ranger 250. Insulate each unused lead individually.

   B. For wire feeders that return a signal for welding output, use an isolation relay to close leads 2 and 4.



   C. Refer to the ***Operation*** section of this manual for maximum wire feeder auxiliary current draw.

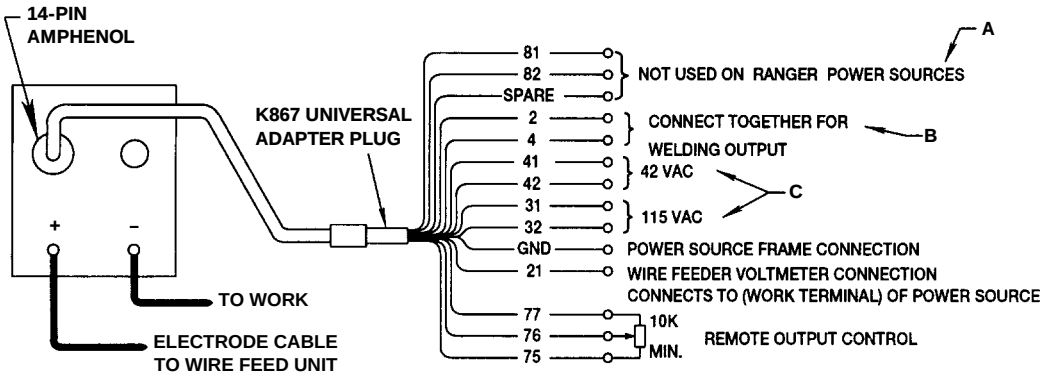
4. Set the "MODE" switch to the "CV-WIRE" position.
5. Place the "IDLER" switch in the "AUTO" position.

⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory – do not adjust above RPM specifications listed in this manual.

6. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
7. Set the ARC control to "0" initially and adjust to suit.
8. Adjust wire feed speed at the wire feeder.

FIGURE C.1 – RANGER 250/K867 UNIVERSAL ADAPTER CONNECTION DIAGRAM



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CONNECTION OF THE LN-25 TO THE RANGER 250 "ACROSS THE ARC" (SEE FIGURE C.2.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-25 to the "-" terminal of the welder. Connect the work cable to the "+" terminal of the welder.

NOTE: Figure C.2 shows the electrode connected for negative polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Ranger 250 output terminals.

NOTE: Welding cable must be sized for current and duty cycle of application.

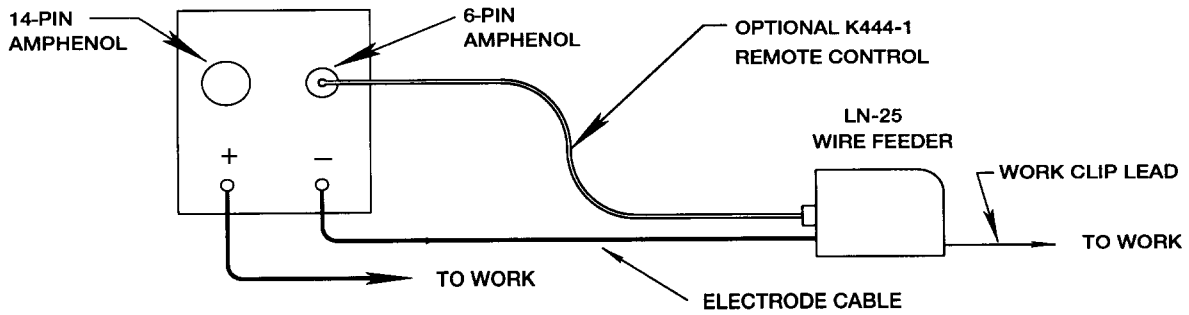
3. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
4. Set the "MODE" switch to the "CV-WIRE" position.
5. Attach the single lead from the LN-25 control box to the work using the spring clip on the end of the lead. This is only a control lead – it carries no welding current.
6. Place the "IDLER" switch in the "AUTO" or "HIGH" position as desired.

⚠ CAUTION

If you are using an LN-25 without an internal contactor, the electrode will be "HOT" when the Ranger 250 is started.

7. Place the "WELD TERMINALS" switch in the "WELD TERMINALS ON" position.
8. Adjust wire feed speed at the LN-25 and adjust the welding voltage with the output "CONTROL" at the LN-25 if optional remote control kit is used.
9. Set the ARC control to "0" initially and adjust to suit.

FIGURE C.2 – RANGER 250/LN-25 ACROSS THE ARC CONNECTION DIAGRAM



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CONNECTION OF THE LN-25 TO THE RANGER 250 WITH 42 VOLT REMOTE OUTPUT CONTROL MODULE (SEE FIGURE C.3.)

1. Shut the welder off.
2. Connect the electrode cable from the K626-XX Input Cable Assembly to the "-" terminal of the welder and to the LN-25 Wire Feeder. Connect the work cable to the "+" terminal of the welder.

NOTE: Figure C.3 shows the electrode connected for negative polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Ranger 250 output terminals.

NOTE: Welding cable must be sized for current and duty cycle of application.

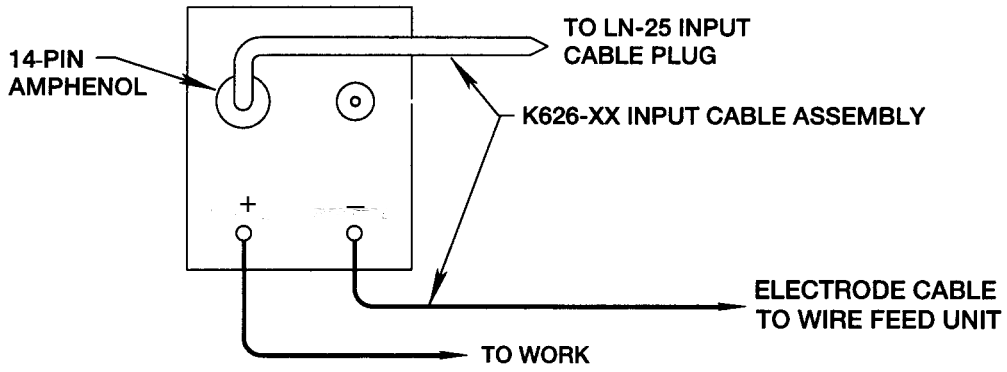
3. Connect the input cable from the K626-XX Input Cable Assembly to the 14-pin amphenol on the Ranger 250 and the input cable plug on the LN-25.
4. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
5. Set the "MODE" switch to the "CV-WIRE" position.
6. Place the "IDLER" switch to the "AUTO" or "HIGH" position as desired.

⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory – do not adjust above RPM specifications listed in this manual.

7. Place the "WELD TERMINALS" switch in the "REMOTELY CONTROLLED" position.
8. Adjust wire feed speed and voltage at the LN-25.
9. Set the ARC control to "0" initially and adjust to suit.

FIGURE C.3 – RANGER 250/LN-25 WITH 42 VOLT REMOTE OUTPUT CONTROL MODULE CONNECTION DIAGRAM



CONNECTION OF THE LN-25 TO THE RANGER 250 "ACROSS THE ARC" WITH K857 REMOTE CONTROL (SEE FIGURE C.4.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-25 to the "-" terminal of the welder. Connect the work cable to the "+" terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

NOTE: Figure C.4 shows the electrode connected for negative polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Ranger 250 output terminals.

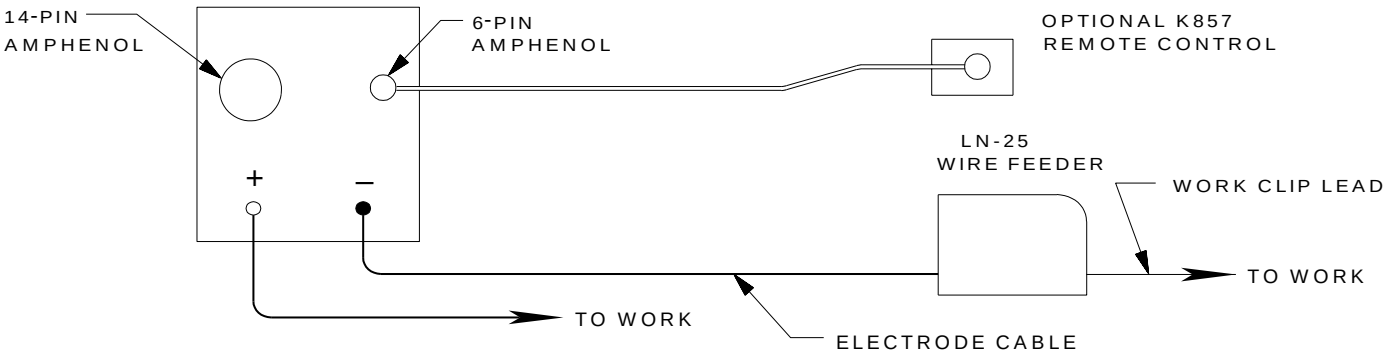
3. Connect the K857 Remote Control to the 6-pin amphenol on the Ranger 250.
4. Attach the single lead from the LN-25 to the work using the spring clip on the end of the lead. This is only a sense lead – it carries no welding current.
5. Place the "IDLER" switch in the "AUTO" or "HIGH" position, as desired.

⚠ CAUTION

If you are using an LN-25 without an internal contactor, the electrode will be "HOT" when the Ranger 250 is started.

6. Set the "MODE" switch to "CV-WIRE."
7. Set the "WELD TERMINALS" switch to "WELD TERMINALS ON."
8. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
9. Adjust wire feed speed at the LN-25 and adjust the welding voltage with the K857 if optional remote control is used.
10. Adjust the "ARC" control to "0" initially and adjust to suit.

FIGURE C.4 – RANGER 250/LN-25 ACROSS THE ARC CONNECTION DIAGRAM WITH K857 REMOTE CONTROL



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CONNECTION OF THE LN-7 TO THE RANGER 250 USING K584 CONTROL CABLE (SEE FIGURE C.5.)

NOTE: If your LN-7 comes equipped with a K291 or K404 input cable, refer to CONNECTION OF THE LN-7 Using K867 UNIVERSAL ADAPTER, rather than this discussion, to connect your Ranger 250 for wire feed welding.

1. Shut the welder off.
2. Connect the electrode cable from the K584-XX Control Cable to the "+" terminal of the welder and to the LN-7 wire feeder. Connect the work cable to the "-" terminal of the welder.

NOTE: Figure C.5 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the output terminals.

NOTE: Welding cable must be sized for current and duty cycle of application.

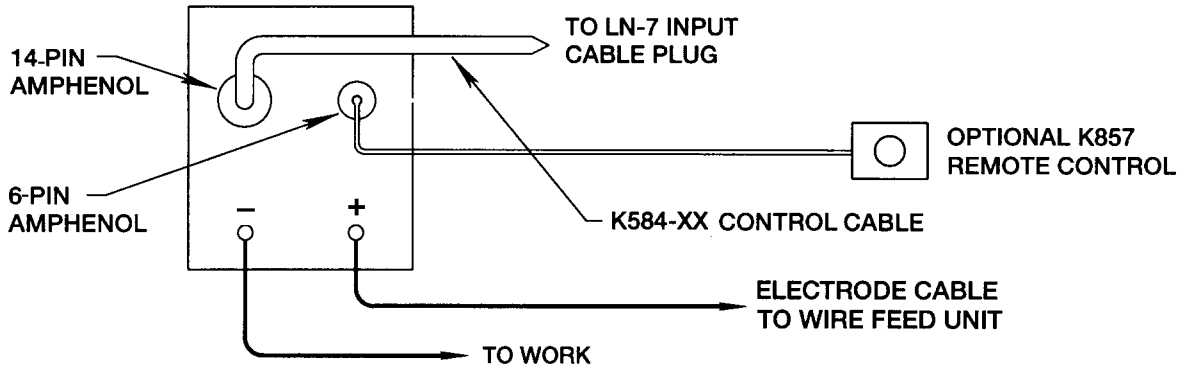
3. Connect the input cable from the K584-XX Control Cable to the 14-pin amphenol on the Ranger 250 and the input cable plug on the LN-7.
4. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
5. Set the "MODE" switch to the "CV-WIRE" position.
6. Place the "IDLER" switch in the "HIGH" position.

⚠ CAUTION

Any increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory – do not adjust above RPM specifications listed in this manual.

7. Place the "WELD TERMINALS" switch in the "REMOTELY CONTROLLED" position.
8. Adjust wire feed speed at the LN-7 and adjust the welding voltage with the optional remote control if used.
9. Set the "ARC" control at "0" initially and adjust to suit.

FIGURE C.5 – RANGER 250/LN-7 WITH 584 CONTROL CABLE CONNECTION DIAGRAM



CONNECTION OF THE LN-8 TO THE RANGER 250 USING K595 CONTROL CABLE (SEE FIGURE C.6.)

NOTE: If your LN-8 comes equipped with a K291 or K404 input cable, refer to CONNECTION OF THE LN-7 Using K867 UNIVERSAL ADAPTER, rather than this discussion, to connect your Ranger 250 for wire feed welding.

1. Shut the welder off.
2. Connect the electrode cable from the LN-8 to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

NOTE: Welding cable must be sized for current and duty cycle of application.

NOTE: Figure C.6 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the Ranger 250 output terminals.

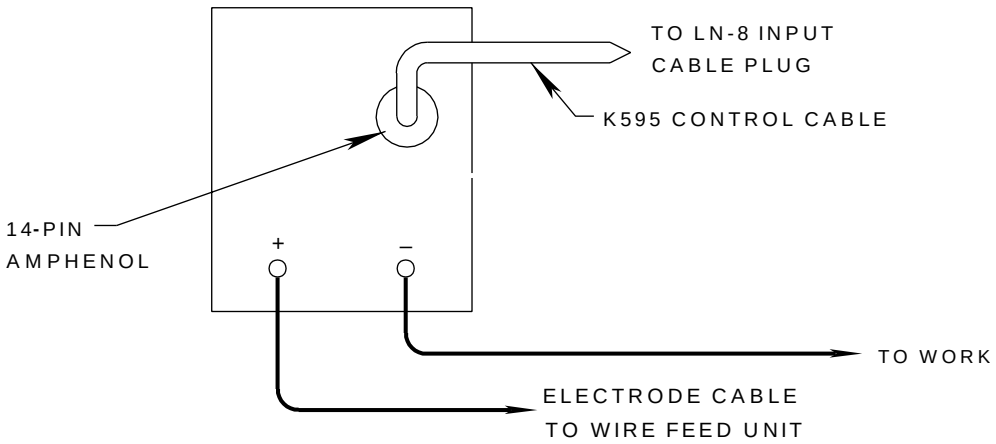
3. Connect the K595-XX Control Cable to the LN-8.
4. Connect the K595-XX to the 14-pin amphenol on the Ranger 250.
5. Place the IDLER switch in the "HIGH" position.

⚠ CAUTION

An increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory – do not adjust above RPM specifications listed in this manual.

6. Set the "VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
7. Set the "MODE" switch to "CV-WIRE."
8. Set the "WELD TERMINALS" switch to "WELD TERMINALS REMOTELY CONTROLLED."
9. Adjust wire feed speed and voltage at the LN-8.
10. Adjust the "ARC" control to "0" initially and adjust to suit.

FIGURE C.6 – RANGER 250/LN-8 WITH K595 CONTROL CABLE CONNECTION DIAGRAM



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CONNECTION OF THE LN-742 TO THE RANGER 250 (SEE FIGURE C.7.)

1. Shut the welder off.
2. Connect the electrode cable from the LN-742 to the "+" terminal of the welder. Connect the work cable to the "-" terminal of the welder.

NOTE: Figure C.7 shows the electrode connected for positive polarity. To change polarity, shut the welder off and reverse the electrode and work cables at the output terminals.

NOTE: Welding cable must be sized for current and duty cycle of application.

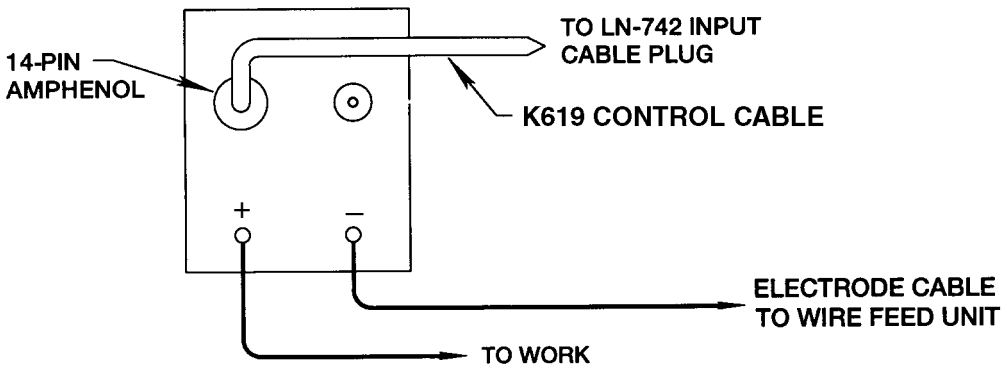
3. Connect the K619 Control Cable to the 14-pin amphenol on the Ranger 250 and the input cable plug on the LN-742.
4. Set the VOLTMETER" switch to "+" or "-" depending on the polarity chosen.
5. Set the "MODE" switch to the "CV-WIRE" position.
6. Place the "IDLER" switch in the "AUTO" or "HIGH" position as desired.

⚠ CAUTION

An increase of the high idle engine RPM by changing the governor setting or overriding the throttle linkage will cause an increase in the AC auxiliary voltage. If this voltage goes over 140 volts, wire feeder control circuits may be damaged. The engine governor setting is preset at the factory – do not adjust above RPM specifications listed in this manual.

7. Place the "WELD TERMINALS" switch in the "REMOTELY CONTROLLED" position.
8. Adjust wire feed speed and voltage at the LN-742.
9. Set the "ARC" control to "0" initially and adjust to suit.

FIGURE C.7 – RANGER 250/LN-742 CONNECTION DIAGRAM



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MAINTENANCE

SAFETY PRECAUTIONS

⚠ WARNING

- Have qualified personnel do all maintenance and troubleshooting work.
- Turn the engine off before working inside the machine.
- Remove guards only when necessary to perform maintenance and replace them when the maintenance requiring their removal is complete. If guards are missing from the machine, obtain replacements from a Lincoln Distributor. (See Operating Manual Parts List.)

Read the Safety Precautions in the front of this manual and in the Engine Owner's Manual before working on this machine.

Keep all equipment safety guards, covers, and devices in position and in good repair. Keep your hands, hair, clothing, and tools away from the fans, and all other moving parts when starting, operating, or repairing the equipment.

ROUTINE AND PERIODIC MAINTENANCE

ENGINE MAINTENANCE

⚠ CAUTION

To prevent the engine from accidentally starting, disconnect the spark plug leads before servicing the engine.

See Table D.1 (Kohler engine) or ***D.2 (Onan Engine)*** for a summary of maintenance intervals for the items listed in ***Table D.3.*** Follow either the hourly or the calendar intervals, whichever comes first. More frequent servicing may be required, depending on your specific application and operating conditions. See ***Figure D.1*** for major component locations.

At the end of each day's use, refill the fuel tank to minimize moisture condensation in the tank. Running out of fuel tends to draw dirt into the fuel system. Also, check the crankcase oil level and add oil if indicated.

TABLE D.1 – KOHLER ENGINE MAINTENANCE SCHEDULE

FREQUENCY	MAINTENANCE REQUIRED
Daily or Before Starting Engine	• Fill fuel tank • Check oil level • Check air cleaner for dirty, loose, or damaged parts • Check air intake and cooling areas, clean as necessary
5 Hours	• First Oil Change
Every 25 Hours	• Service air pre-cleaner
Every 100 Hours	• Change engine oil[1] • Replace fuel filter element • Clean or replace air filter element[1] • Clean spark arrestor
Every 200 Hours	• Replace oil filter[1] • Check spark plug and gap
Every 2 Years	• Check fuel lines and clamps

[1]Service more frequently when used in dusty areas and/or at high ambient temperatures.

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TABLE D.2 – ONAN ENGINE MAINTENANCE SCHEDULE

FREQUENCY	MAINTENANCE REQUIRED
Daily or Before Starting Engine	• Fill fuel tank • Check oil level • Check air cleaner for dirty, loose, or damaged parts • Check air intake and cooling areas, clean as necessary
5 Hours	• First Oil Change
Every 50 Hours	• Service air pre-cleaner • Change engine oil[1]
Every 100 Hours	• Replace oil filter[1] • Clean spark arrestor
Every 200 Hours	• Clean or replace air filter element[1] • Replace fuel filter element
Every 500 Hours	• Check spark plug and gap
Every 2 Years	• Check fuel lines and clamps

[1]Service more frequently when used in dusty areas and/or at high ambient temperatures.

TABLE D.3 – ENGINE MAINTENANCE COMPONENTS

ITEM	MAKE AND PART NUMBER	
	ONAN P216 ENGINE	KOHLER CH20 ENGINE
Oil Filter	Onan 122-0645, Fram PH3614	Kohler 1205001, Fram PH3614
Air Filter Element	Onan 140-2628-01, Fram CA140PL	Kohler 4708303, Fram CA79
Air Filter Pre-Cleaner	Onan 140-1496	Kohler 2408302
Fuel Filter	Onan 149-2005, Fram G1	Kohler 2505002, Fram G1
Spark Plug	Onan 167-0263, Champion RS14YC (.025" Gap)	Champion RC12YC (.030" Gap)
Battery	BCI Group 58 (435 CCA)	BCI Group 58 (435 CCA)

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ENGINE OIL CHANGE

Drain the oil while the engine is warm to assure rapid and complete draining.

1. Remove the oil filler cap and dipstick. Remove the yellow cap from the oil drain valve and attach the flexible drain tube supplied with the machine. Push in and twist the drain valve counterclockwise. Pull the valve out and drain the oil into a suitable container.
2. Close the drain valve by pushing in and twisting clockwise. Replace the yellow cap.
3. Refill to the upper limit mark on the dipstick with the recommended oil. Tighten the oil filler cap securely.

Engine Oil Refill Capacities

Without oil filter replacement:
- 1.7 US qt. (1.4 Imp qt., 1.6 liter) - Kohler
- 1.6 US qt. (1.3 Imp qt., 1.5 liter) - Onan

With oil filter replacement:
- 2.0 US qt. (1.7 Imp qt., 1.9 liter) - Kohler
- 1.8 US qt. (1.5 Imp qt., 1.7 liter) - Onan

Use 4-cycle motor oil that meets or exceeds the requirements for API service classification SG or SH. Always check the API SERVICE label on the oil container to be sure it includes the letters SG or SH.

SAE 10W-30 is recommended for general, all-temperature use, -5°F to 104°F (-20°C to 40°C). For the Onan engine, it is recommended that SAE 30 oil be used above 82°F (27°C). See the engine Owner's Manual for more specific information on oil viscosity recommendations.

Wash your hands with soap and water after handling used oil.

Please dispose of used motor oil in a manner that is compatible with the environment. We suggest you take it in a sealed container to your local service station or recycling center for reclamation. Do not throw it in the trash, pour it on the ground or down a drain.

OIL FILTER CHANGE

1. Drain the engine oil.
2. Remove the oil filter, and drain the oil into a suitable container. Discard the used oil filter.
3. Clean the filter mounting base and coat the gasket of the new oil filter with clean engine oil.
4. Screw on the new oil filter by hand, until the gasket contacts the filter mounting base. Then use an oil filter socket tool to tighten the filter an additional 1/2 to 7/8 turn.
5. Refill the crankcase with the specified amount of the recommended oil. Reinstall the oil filler cap.
6. Start the engine and check for oil filter leaks.
7. Stop the engine and check the oil level. If necessary, add oil to the upper limit mark on the dipstick.

AIR CLEANER SERVICE

A dirty air cleaner will restrict air flow to the carburetor. To prevent carburetor malfunction, service the air cleaner regularly. Service more frequently when operating the engine in extremely dusty areas.

⚠ WARNING

Never use gasoline or low flash point solvents for cleaning the air cleaner element. A fire or explosion could result.

⚠ CAUTION

Never run the engine without the air cleaner. Rapid engine wear will result from contaminants, such as dust and dirt being drawn into the engine.

Air Pre-Cleaner Service

1. Loosen the cover retaining knob and remove the cover.
2. Remove the pre-cleaner from the paper element.
3. Wash the pre-cleaner in warm water with detergent. Rinse the pre-cleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow the pre-cleaner to air dry.
4. Saturate the pre-cleaner with new engine oil. Squeeze out all excess oil.
5. Reinstall the pre-cleaner over the paper element.
6. Reinstall the air cleaner cover. Secure the cover with the cover retaining knob.

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Air Filter Paper Element Service

1. Loosen the cover retaining knob and remove the cover.
2. Remove the pre-cleaner from the paper element.
3. Remove the element cover nut, element cover, and paper element.
4. Do not wash the paper element or use pressurized air, as this will damage the element. Replace a dirty, bent, or damaged element with a new element. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.
5. When servicing the air cleaner, check the air cleaner base. Make sure it is secured and not bent or damaged. Also check the element cover for damaged or improper fit. Replace all damaged air cleaner components.

NOTE: Before the air cleaner is reassembled, make sure rubber seal is in position around the stud. Inspect, making sure it is not damaged and seals with the element cover.

6. Reinstall the paper element, pre-cleaner, element cover, element cover nut, and air cleaner cover. Secure the cover with the cover retaining knob.

SPARK PLUG SERVICE

To ensure proper engine operation, the spark plugs must be properly gapped and free of deposits.

⚠ WARNING

The muffler becomes very hot during operation and remains hot for a while after stopping the engine. Be careful not to touch the muffler while it is hot.

1. Remove the spark plug cap.
2. Clean any dirt from around the spark plug base.
3. Use a plug wrench to remove the spark plugs.
4. Visually inspect the spark plugs. Discard them if the insulator is cracked or chipped. Clean the spark plug with a wire brush if it is to be reused.
5. Measure the plug gap with a feeler gauge. Correct as necessary by bending the side electrode.
6. Check that the spark plug washer is in good condition and thread the spark plug in by hand to prevent cross-threading.
7. After the spark plug is seated, tighten with a spark plug wrench to compress the washer.
   - If installing a new spark plug, tighten 1/2 turn after the spark plug seats to compress the washer.
   - If reinstalling a used spark plug, tighten 1/8 - 1/4 turn after the spark plug seats to compress the washer.

Spark Plug Gap: .030 in. (0.76 mm)-Kohler
.025 in. (0.64 mm)-Onan

Spark Plug Torque: 20 ft. Lb. (27 N-m)-Kohler
11 ft. Lb. (14 N-m)-Onan

⚠ CAUTION

The spark plug must be securely tightened. An improperly tightened spark plug can become very hot and may cause engine damage.

Use only the recommended spark plug or equivalent. A spark plug which has an improper heat range may cause engine damage.

FUEL FILTER SERVICE

1. Check the fuel filter for water accumulation or sediment.
2. Replace the fuel filter if it is found with excessive water accumulation or sediment.

ENGINE ADJUSTMENT

⚠ WARNING

OVERSPEED IS HAZARDOUS.
The maximum allowable high idle speed for this machine is 3750 RPM, no load. Do NOT tamper with governor components or setting or make any other adjustments to increase the maximum speed. Severe personal injury and damage to the machine can result if operated at speeds above maximum.

Adjustments to the engine are to be made only by a Lincoln Service Center or an authorized Field Service Shop.

MAINTENANCE

BATTERY MAINTENANCE

To access the battery, remove the screws from the rear battery tray using a screwdriver or a 3/8" socket. Slide the battery tray out only far enough to access the battery terminals.

⚠ WARNING

GASES FROM BATTERY can explode.

- Keep sparks, flame, and cigarettes away from battery.

To prevent EXPLOSION when:

- **INSTALLING A NEW BATTERY -** Disconnect the negative cable from the old battery first and connect to the new battery last.
- **CONNECTING A BATTERY CHARGER -** Remove the battery from the welder by disconnecting the negative cable first, then the positive cable and battery clamp. When reinstalling, connect the negative cable last. Keep the area well ventilated.
- **USING A BOOSTER -** Connect the positive lead to the battery first, then connect the negative lead to the engine foot.

BATTERY ACID can burn eyes and skin.

- Wear gloves and eye protection and be careful when working near a battery.
- Follow the instructions printed on the battery.

CLEANING THE BATTERY

Keep the battery clean by wiping it with a damp cloth when dirty. If the terminals appear corroded, disconnect the battery cables and wash the terminals with an ammonia solution or a solution of 1/4 pound (0.113 kg) of baking soda and 1 quart (0.946 l) of water. Be sure the battery vent plugs (if equipped) are tight so that none of the solution enters the cells.

After cleaning, flush the outside of the battery, the battery compartment, and surrounding areas with clear water. Coat the battery terminals lightly with petroleum jelly or a non-conductive grease to retard corrosion.

Keep the battery clean and dry. Moisture accumulation on the battery can lead to more rapid discharge and early battery failure.

CHECKING ELECTROLYTE LEVEL

If battery cells are low, fill them to the neck of the filler hole with distilled water and recharge. If one cell is low, check for leaks.

CHARGING THE BATTERY

When you charge, jump, replace, or otherwise connect battery cables to the battery, be sure the polarity is correct. Improper polarity can damage the charging circuit. The Ranger 250 positive (+) battery terminal has a red terminal cover.

If you need to charge the battery with an external charger, disconnect the negative cable first, then the positive cable before you attach the charger leads. After the battery is charged, reconnect the positive battery cable first and the negative cable last. Failure to do so can result in damage to the internal charger components.

Follow the instructions of the battery charger manufacturer for proper charger settings and charging time.

OPTIONAL SPARK ARRESTOR

⚠ WARNING

MUFFLER MAY BE HOT.

Allow the engine to cool before installing the spark arrestor!

Do not operate the engine while installing the spark arrestor!

Clean the spark arrestor after every 100 hours of use.

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WELDER/GENERATOR MAINTENANCE

STORAGE

Store the Ranger 250 in clean, dry, protected areas.

CLEANING

Blow out the generator and controls periodically with low pressure air. Do this at least once a week in particularly dirty areas.

RECEPTACLES

Keep the electrical receptacles in good condition. Remove any dirt, oil, or other debris from their surfaces and holes.

CABLE CONNECTIONS

Check the welding cable connections at the weld output terminals often. Be sure that the connections are always firm.

BRUSH REMOVAL AND REPLACEMENT

It's normal for the brushes and slip rings to wear and darken slightly. Inspect the brushes when a generator overhaul is necessary.

⚠ CAUTION

Do not attempt to polish slip rings while the engine is running.

⚠ WARNING

Service and repair should only be performed by Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions.

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FIGURE D.1 – MAJOR COMPONENT LOCATIONS

1. CASE COVER AND DOOR ASSEMBLY/CASE BACK
2. ENGINE
3. IDLER SOLENOID
4. ROTOR/STATOR
5. POWER MODULE ASSEMBLY
6. POWER CAPACITORS
7. PC BOARDS
8. FRONT PANEL (OUTPUT) ASSEMBLY
9. CONTROL PANEL
10. OUTPUT CHOKE
11. OUTPUT RECTIFIER BRIDGE
12. FUEL TANK
13. MACHINE BASE
14. BATTERY

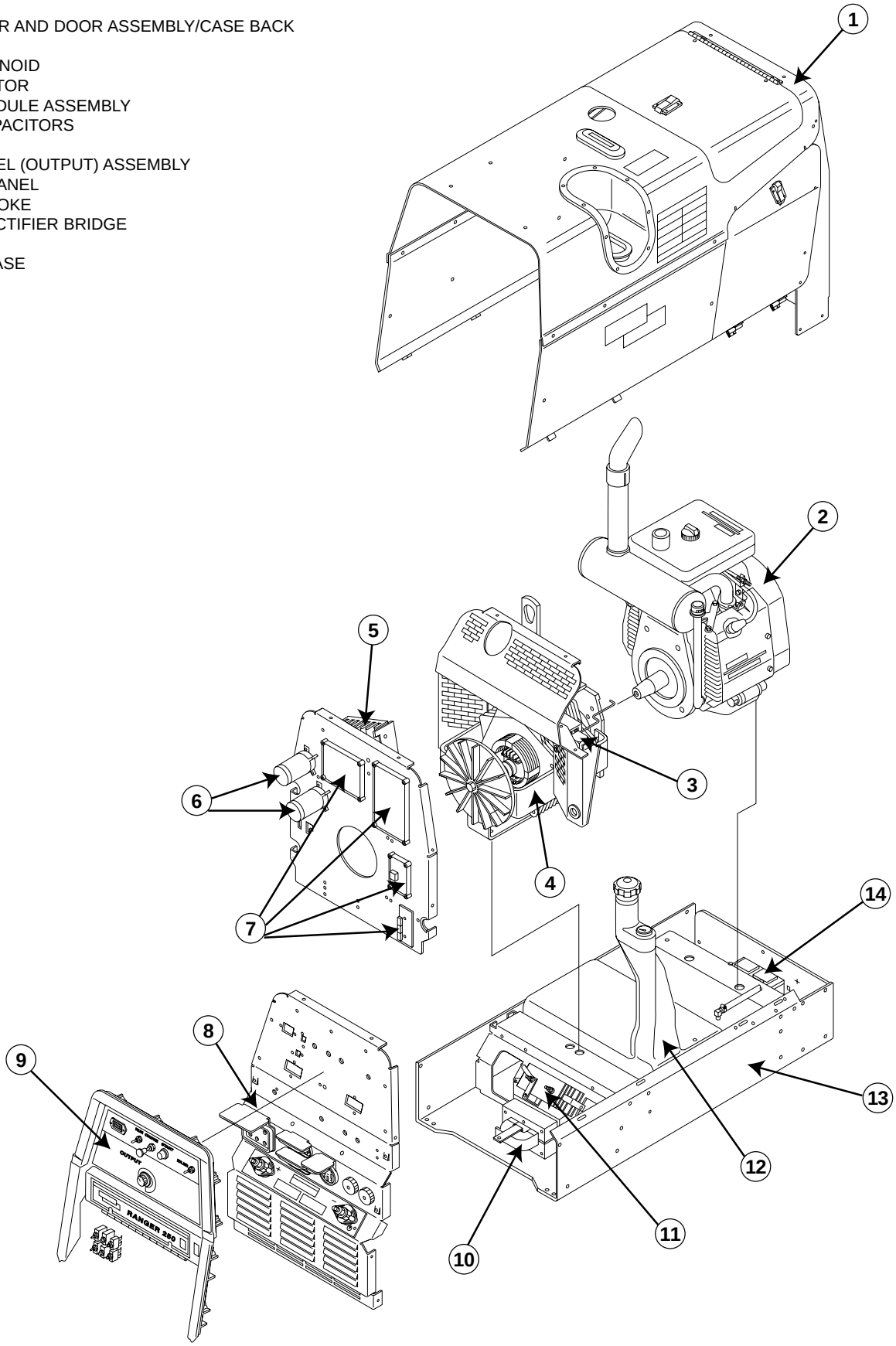

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FIGURE E.1 – RANGER 250 BLOCK LOGIC DIAGRAM

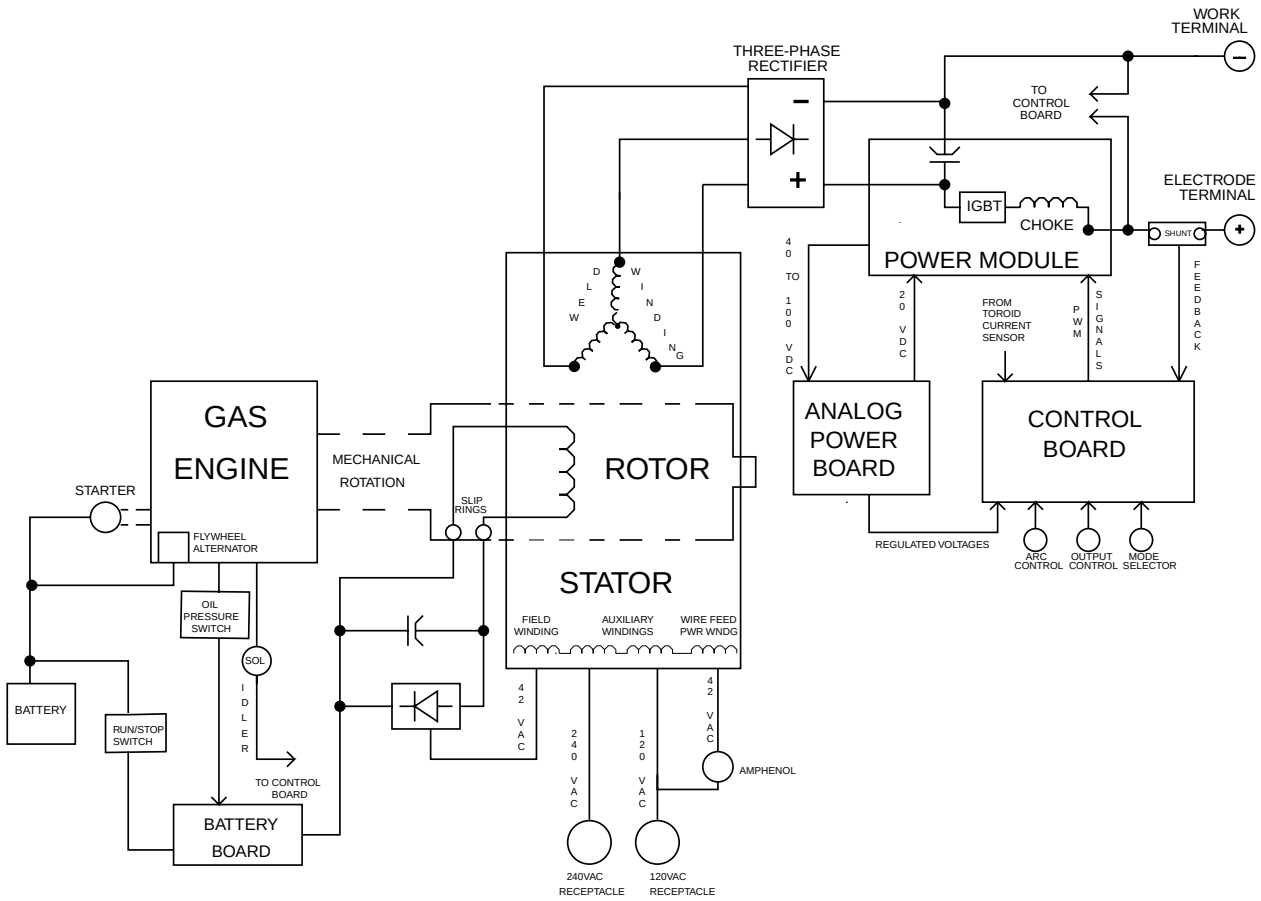

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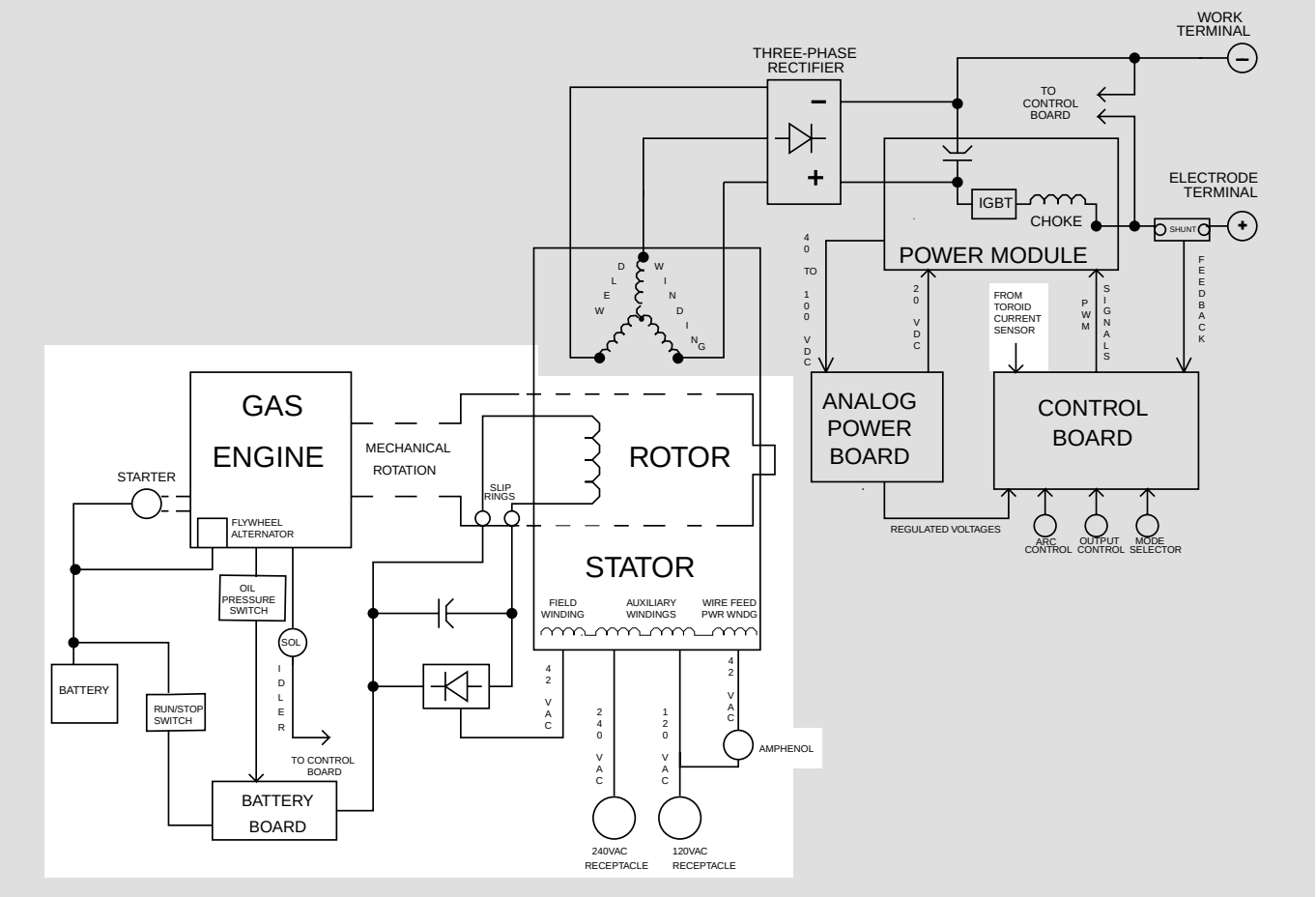
FIGURE E.2 – BATTERY, STARTER, ENGINE, ROTOR, STATOR AND ENGINE PROTECTION



GENERAL DESCRIPTION

The Ranger 250 is a gasoline engine-driven welding power source capable of producing 250 amps at 25VDC at a 100% duty cycle. The engine is coupled to a brush-type alternating current generator. This AC output is rectified and controlled by ***Chopper Technology*** to produce DC current for multi-purpose welding applications. The Ranger 250 is also capable of producing 8,000 watts of AC auxiliary power at 100% duty cycle.

BATTERY, ENGINE, ROTOR, STATOR AND ENGINE PROTECTION

The 12VDC battery powers the engine starter motor and also supplies power to the battery PC board and associated circuitry. When the engine, which is mechanically coupled to the rotor, is started and running, the 12 VDC battery voltage is fed through the battery board to the rotor field coil via a brush and slip ring configuration. This excitation or “flashing” voltage magnetizes the rotor lamination. This rotating magnet induces a voltage in the stationary windings of the main alternator stator. The stator houses a three-phase weld winding, a 120/240VAC single-phase auxiliary winding, a 42VAC wire feeder power winding, and a separate 42VAC field feedback winding that is rectified and serves as a feedback supply for the rotor field winding.

The engine flywheel alternator supplies charging current for the battery circuit. The oil pressure switch monitors engine oil pressure. If a low oil pressure condition should develop, the engine will shut down and the battery PC board will disable the rotor flashing current. The idler solenoid is mechanically connected to the engine’s throttle linkage. If no welding or auxiliary current is being drawn from the Ranger 250, the control board activates the idler solenoid, which then brings the engine to a low idle state. When either welding or auxiliary current is detected at the toroid current sensor, the control board deactivates the idler solenoid and the engine returns to high RPM.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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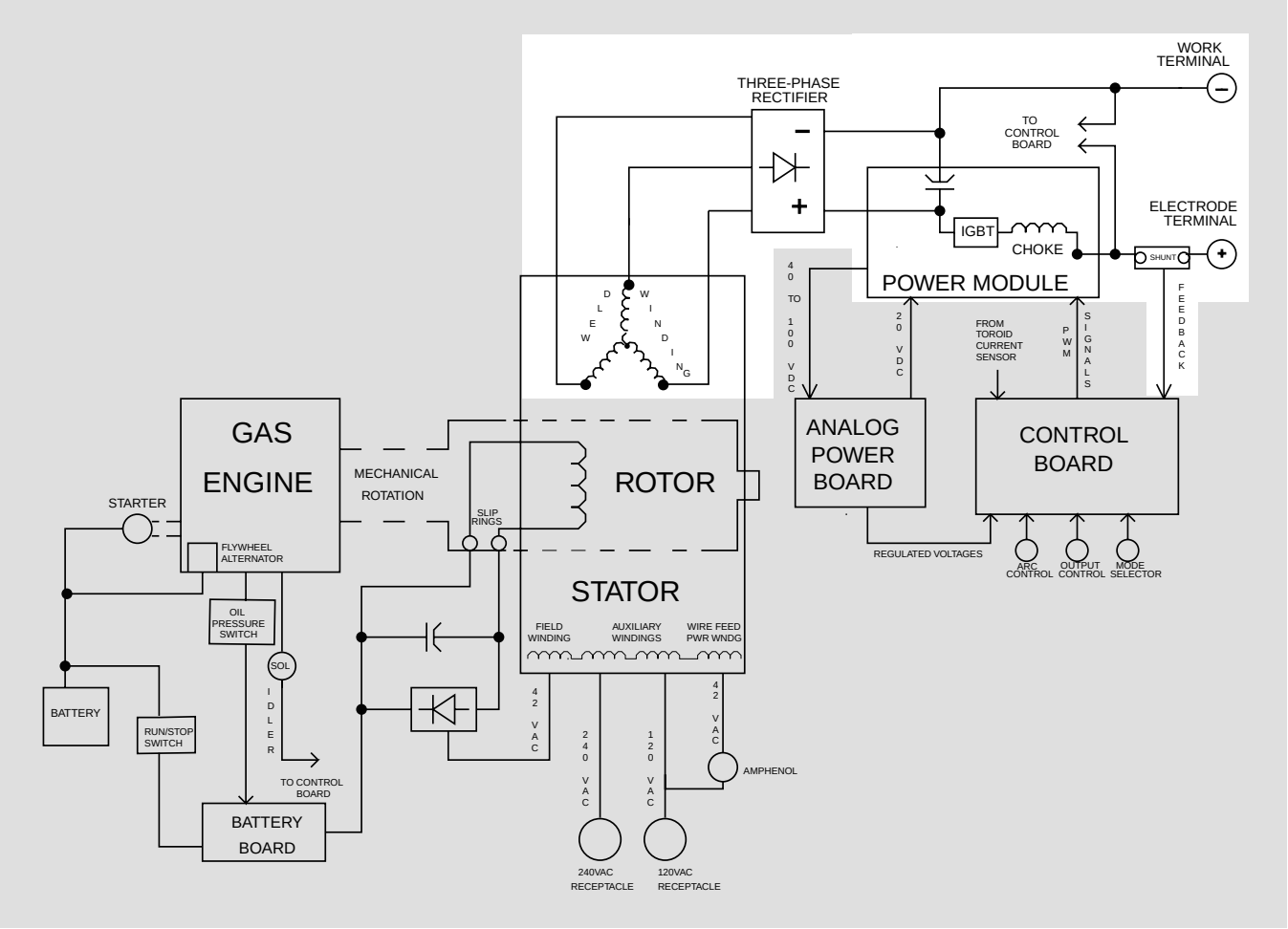
FIGURE E.3 – WELD WINDINGS, RECTIFIER, POWER MODULE AND FEEDBACK



WELD WINDINGS, RECTIFIER, POWER MODULE AND FEEDBACK

The three-phase stator weld windings are connected to a three-phase rectifier bridge. The resultant DC voltage is applied to parallel capacitors incorporated within the power module. These capacitors function as filters and also as power supplies for the IGBT. See ***IGBT Operation*** in this section. The IGBT acts as a high-speed switch operating at 20KHZ. This device is switched on and off by the control board through pulsewidth modulation circuitry. See ***Pulse Width Modulation*** in this section. This “chopped” DC output is applied through a choke coil and shunt to the welding output terminals. The choke functions as a current filter. Free-wheeling diodes are incorporated in the power module to provide a current path for the stored energy in the chokes when the IGBT is turned off. See ***Chopper Technology*** in this section.

Output voltage and current feedback information is fed to the control board. This information is sensed from the output terminal circuits and the shunt.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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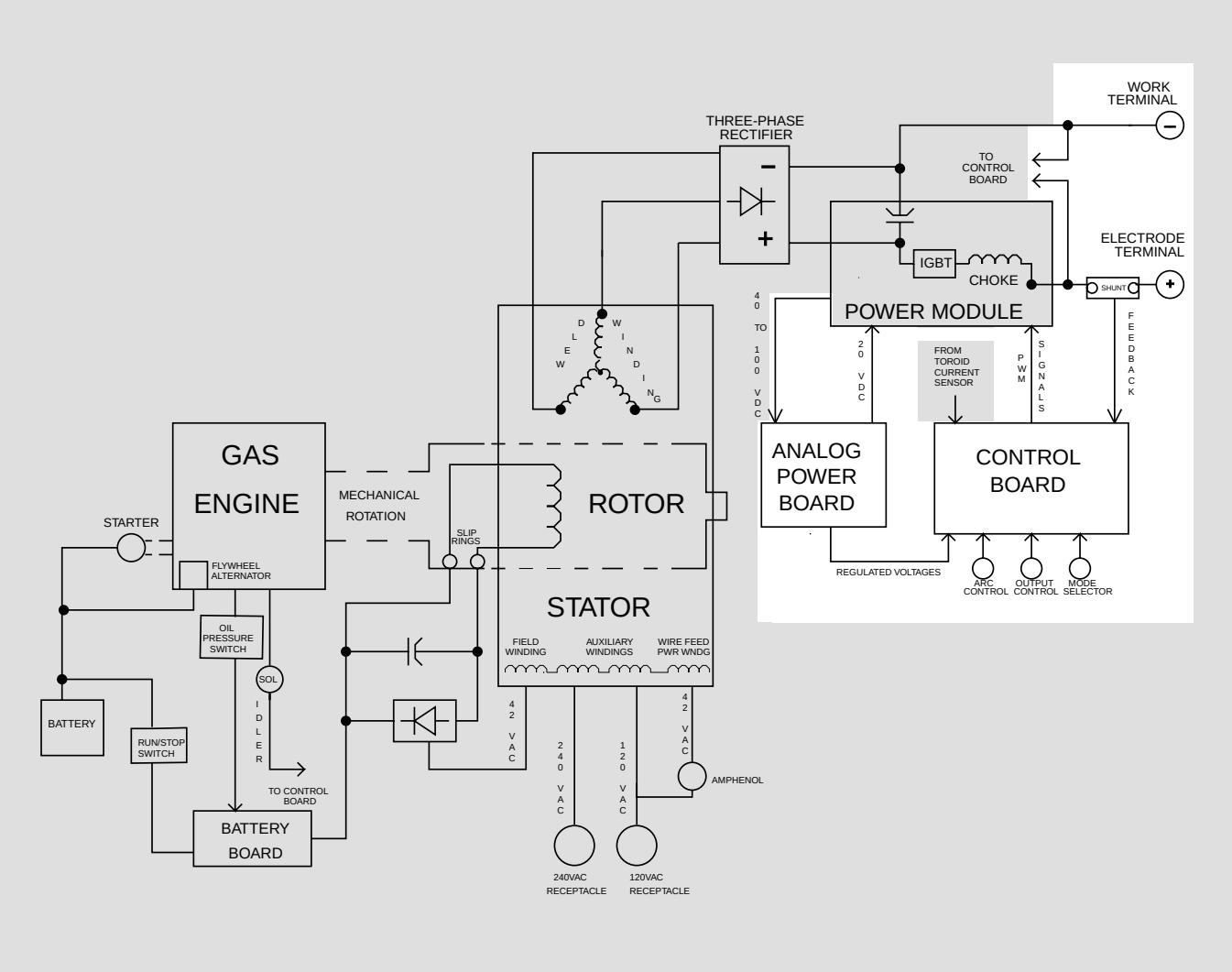
FIGURE E.4 – ANALOG POWER BOARD AND CONTROL BOARD



ANALOG POWER BOARD AND CONTROL BOARD

The analog power board, which is powered by the two filter capacitors on the power module, supplies various regulated DC voltages to operate the control board circuitry. It also supplies a regulated DC voltage to operate the chopper board.

The control board monitors the operator controls (arc control, output, and mode selector). It compares these commands to the current and voltage feedback information it receives from the shunt and output terminal circuits. The circuitry on the control board determines how the output should be controlled to optimize welding results, and it sends the correct PWM signals to the IGBT driver circuit.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion.

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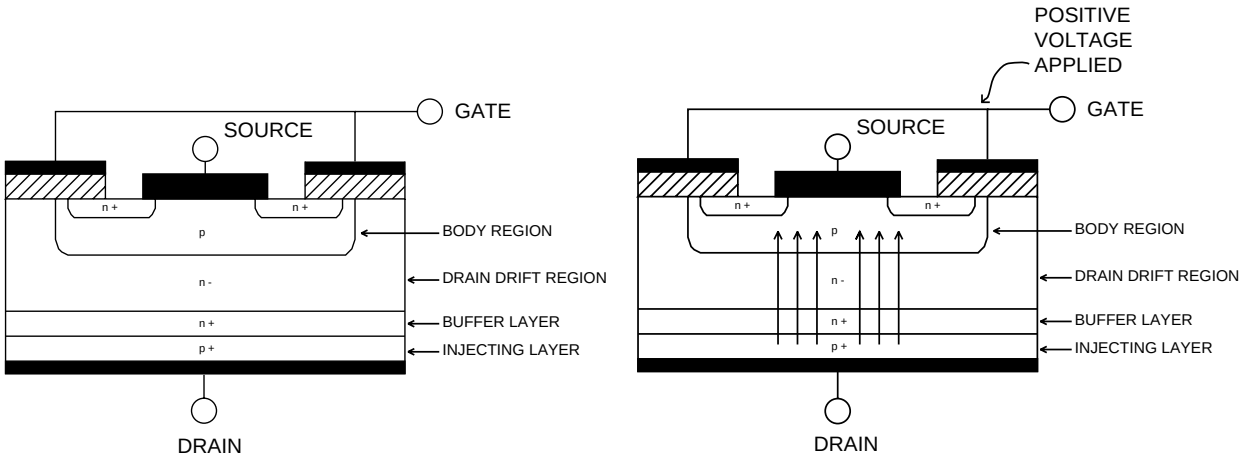
THEORY OF OPERATION

FIGURE E.5 – IGBT OPERATION



A. PASSIVE

B. ACTIVE

INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION

An IGBT is a type of transistor. IGBTs are semiconductors well suited for high frequency switching and high current applications.

Drawing A shows an IGBT in a passive mode. There is no gate signal, zero volts relative to the source, and therefore, no current flow. The drain terminal of the IGBT may be connected to a voltage supply; but since there is no conduction the circuit will not supply current to components connected to the source. The circuit is turned off like a light switch in the OFF position.

Drawing B shows the IGBT in an active mode. When the gate signal, a positive DC voltage relative to the source, is applied to the gate terminal of the IGBT, it is capable of conducting current. A voltage supply connected to the drain terminal will allow the IGBT to conduct and supply current to circuit components coupled to the source. Current will flow through the conducting IGBT to downstream components as long as the positive gate signal is present. This is similar to turning ON a light switch.

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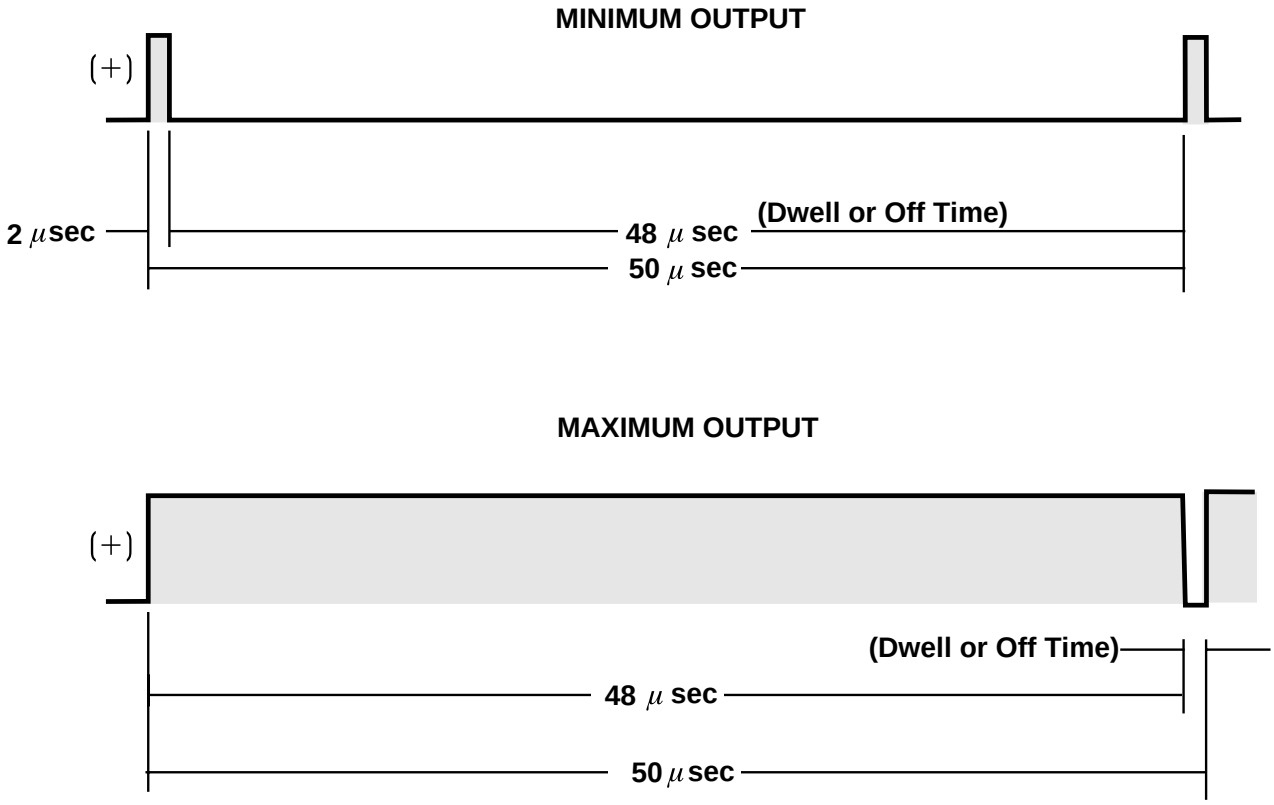
FIGURE E.6 – TYPICAL IGBT OUTPUTS



PULSE WIDTH MODULATION

The term PULSE WIDTH MODULATION is used to describe how much time is devoted to conduction in the cycle. Changing the pulse width is known as MODULATION. Pulse Width Modulation (PWM) is the varying of the pulse width over the allowed range of a cycle to affect the output of the machine.

MINIMUM OUTPUT

By controlling the duration of the gate signal, the IGBT is turned on and off for different durations during a cycle. The top drawing shows the minimum output signal possible over a 50-microsecond time period.

The positive portion of the signal represents one IGBT group conducting for 2 microsecond. The dwell time (off time) is 48 microseconds. Since only 2 microseconds of the 50-microsecond time period is devoted to conducting, the output power is minimized.

MAXIMUM OUTPUT

By holding the gate signals on for 48 microseconds and allowing only 2 microseconds of dwell time (off time) during the 50-microsecond cycle, the output is maximized. The darkened area under the top curve can be compared to the area under the bottom curve. The more darkened area under the curve, the more power is present.

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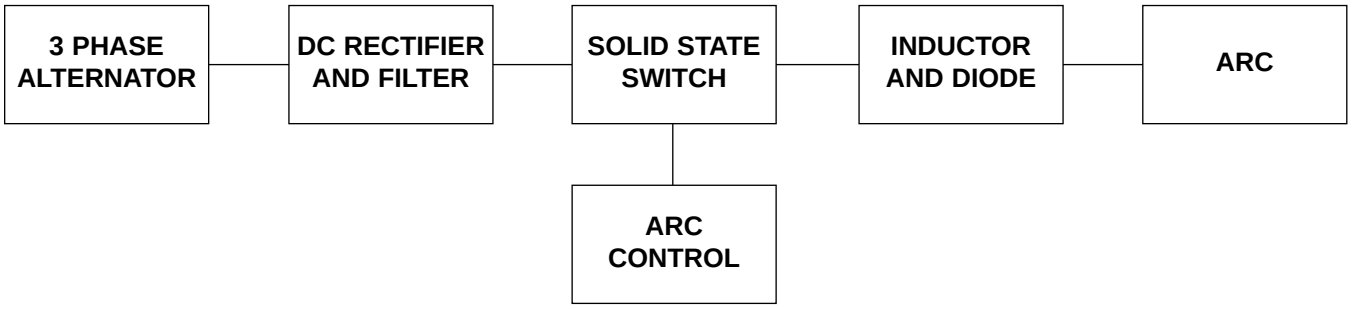
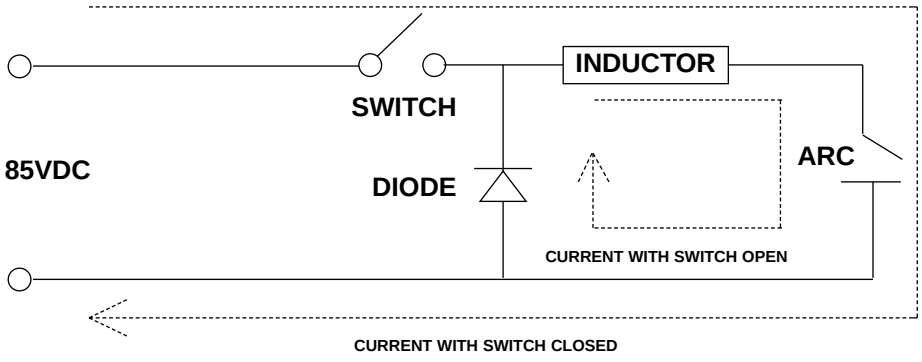
CHOPPER TECHNOLOGY FUNDAMENTALS

The new era of welding machines such as the Ranger 250 employ a technology whereby a DC source is turned on and off (chopped up) at high speed, thensmoothed through an inductor to control an arc. Hence the name “Chopper.” The biggest advantage of chopper technology is the high-speed control of the arc, similar to the inverter machines. A block diagram for this is as follows:



In this system, the engine drives a three-phase alternator, which generates power that is rectified and filtered to produce about 85VDC. The current is applied through a solid state switch to an inductor. By turning the switch on and off, current in the inductor and the arc can be controlled. The following diagram depicts the current flow in the system when the switch is open and closed:



When the switch is closed, current is applied through the inductor to the arc. When the switch opens, current stored in the inductor sustains flow in the arc and through the diode. The repetition rate of switch closure is 20Khz, which allows ultra-fast control of the arc. By varying the ratio of on time versus off time of the switch (Duty Cycle), the current applied to the arc is controlled. This is the basis for Chopper Technology: Controlling the switch in such a way as to produce superior welding.

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TROUBLESHOOTING & REPAIR

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM). Look under the column labeled "PROBLEM" (SYMPTOMS). This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into four main categories: Output Problems, Function Problems, Engine Problems, and Welding Problems.

Step 2. PERFORM EXTERNAL TESTS. The second column, labeled "POSSIBLE AREAS OF MISADJUSTMENT(S)", lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In general, these tests can be conducted without removing the case cover.

Step 3. PERFORM COMPONENT TESTS. The last column, labeled "Recommended Course of Action" lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify that the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this section. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the referred to test points, components, terminal strips, etc., can be found on the referenced electrical wiring diagrams and schematics. Refer to the Electrical Diagrams Section Table of Contents to locate the appropriate diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PC BOARD TROUBLESHOOTING PROCEDURES

⚠ WARNING

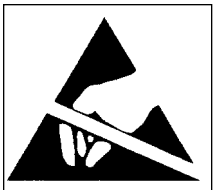
ELECTRIC SHOCK can kill.

Have an electrician install and service this equipment. Turn the machine OFF before working on equipment. Do not touch electrically hot parts.

Sometimes machine failures appear to be due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and replacing PC boards, please use the following procedure:

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.
2. Check for loose connections at the PC board to assure that the PC board is properly connected.
3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock. Read the warning inside the static resistant bag and perform the following procedures:

PC Board can be damaged by static electricity.



ATTENTION
Static-Sensitive Devices
Handle only at Static-Safe Workstations

Reusable Container
Do Not Destroy

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an unpainted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.
- Tools which come in contact with the PC Board must be either conductive, anti-static or static-dissipative.
- Remove the PC Board from the static-shielding bag and place it directly into the equipment. Don't set the PC Board on or near paper, plastic or cloth which could have a static charge. If the PC Board can't be installed immediately, put it back in the static-shielding bag.
- If the PC Board uses protective shorting jumpers, don't remove them until installation is complete.
- If you return a PC Board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.

4. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

NOTE: Allow the machine to heat up so that all electrical components can reach their operating temperature.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
    a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks, and terminal strips.
    b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.
6. Always indicate that this procedure was followed when warranty reports are to be submitted.

NOTE: Following this procedure and writing on the warranty report, "INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM," will help avoid denial of legitimate PC board warranty claims.

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TROUBLESHOOTING & REPAIR

Observe Safety Guidelines detailed in the beginning of this manual.

TROUBLESHOOTING GUIDE

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
Major physical or electrical damage is evident.	1. Contact your local Lincoln Authorized Field Service Facility.	1. Contact the Lincoln Electric Service Department at 1-800-833-9353 (WELD).
No welding output in all modes. The engine operates normally. The auxiliary output is normal.	1. Place the Welding Terminals switch in the "WELD TERMINALS ON" position. If the problem is solved, the fault may be in the external control cable (if used), leads #2 and #4. See the Wiring Diagram. 2. With the engine at high idle (3700RPM), the machine in the Stick mode and the OUTPUT CONTROL at maximum, check for the presence of approximately 80VDC (open circuit voltage) at the output terminals. 3. If the correct OCV is present at the welding output terminals, check the welding cables, clamps and electrode holder for loose or faulty connections. 4. Air flow may be blocked or restricted.	1. Check for loose or faulty connections on the heavy current carrying leads between the output bridge, the power module, the choke, the shunt and the output terminals. Check thermostat TS1 and associated wiring. See the Wiring Diagram. 2. Check the Welding Terminals switch and associated leads (2 and 4). See the Wiring Diagram. 3. If the correct OCV is present when the Welding Terminals switch is in the "WELD TERMINALS ON" position, the Bypass Board may be faulty. Also check associated wiring. See the Wiring Diagram. 4. Check gate leads (#23 and #25) for loose or faulty connections. See the Wiring Diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No welding output in all modes. The engine operates normally. The auxiliary output is normal. *(continued)*		5. Perform the ***Stator Voltage Test.*** 6. Perform the ***Output Rectifier Bridge Test.*** 7. Perform the ***Power Module Test.*** 8. Perform the ***Analog Power Board Test.*** 9. Check the output control potentiometer and associated wiring. 10. The Control Board may be faulty.
No welding output in all modes. Also no auxiliary power. The engine operates normally at approximately 3700 RPM.	1. Check the brushes for wear and proper contact to the rotor slip rings. 2. Make sure the engine is operating at the correct high idle speed (3700 RPM). 3. Check for loose or faulty connections or leads at the auxiliary output receptacles and/or the welder output terminals. See the Wiring Diagram.	1. Perform the ***Rotor Resistance Test.*** 2. Perform the ***Flashing and Rotor Voltage Test.*** If the "flashing" voltage is not present, the battery board or leads #201 or #200 may be faulty. See the Wiring Diagram. Also, make sure that lead #5H has continuity (zero ohms) to ground. 3. Check the field diode and capacitor. Replace if necessary. 4. Perform the ***Stator Voltage Test.***

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No auxiliary power at the receptacles. The welding output is normal and the engine operates normally.	1. The circuit breakers may be tripped. Reset if necessary. 2. Check for loose or faulty connections at the auxiliary receptacles.	1. Check the wiring between the auxiliary receptacles, the connection studs, and the main stator. See the Wiring Diagram. 2. Perform the ***Stator Voltage Test.***
The machine has welding output but no control of output in some or all modes. The auxiliary power is normal.	1. If a remote control unit is connected, check the remote control and related cable. 2. Check the welding and work cables for loose or faulty connections.	1. Check the OUTPUT control potentiometer and related leads. See the Wiring Diagram. 2. Check the shunt and associated feedback leads. See the Wiring Diagram. 3. Check the voltage feedback leads for loose or faulty connections. See the Wiring Diagram. 4. Perform the ***Power Module Test.*** 5. The Control Board may be faulty.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The machine has low welding output and low auxiliary output.	1. The engine RPM may be low. 2. Check the brushes for wear and proper contact to the slip rings.	1. If the engine high idle speed is low, perform the ***Engine Throttle Adjustment Test.*** 2. Perform the ***Rotor Resistance Test.*** 3. Perform the ***Flashing and Rotor Voltage Test.*** If the rotor voltage is low, the field capacitor or field bridge may be faulty. Test and replace if necessary. See the Wiring Diagram. 4. If the engine high idle RPM is OK but slows down excessively under load, then the engine may have lost horsepower and be in need of major repair.
The machine control is still active when the remote control unit is connected.	1. This is normal in TIG mode. 2. The remote control unit may be defective. 3. Check the amphenol connections and associated wiring.	1. Check Plug J10 on the Control Board for loose or faulty connections. 2. The bypass board may be faulty. 3. The Control Board may be faulty.
Machine seems to be locked into the CC mode of operation (stick mode.)	1. Check the position of the Mode Selector switch. It must be in the correct position for the process being used. 2. Check that jumper plug J3 is properly installed in the Control Board. (J3 has a jumper wire from pin 1 to pin 5.) 3. Make sure plug J2 is properly connected to the Control Board.	1. Check the Mode Selector switch and associated wiring. See the Wiring Diagram. 2. The Control Board may be faulty.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The wire feeder does not work when connected to the welder amphenol.	1. Check the appropriate circuit breaker (CB1 or CB8). Reset if tripped. 2. The wire feeder control cable may be faulty. 3. The wire feeder may be faulty.	1. Check for the presence of appropriate source voltage at the 14-pin amphenol. 2. If the appropriate voltage (42 VAC or 115 VAC) is NOT present at the 14-pin amphenol, check for loose or faulty connections. See the Wiring Diagram. 3. Perform the ***Stator Voltage Test.***
The battery does not stay charged.	1. Check for loose or faulty connections at the battery and engine charging system. 2. The battery may be faulty. Check or replace.	1. If the yellow engine alternator light is on, perform the ***Flywheel Alternator Test.*** 2. If the battery is not charging and the yellow engine alternator light is not lit. The battery board may be faulty.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine will not crank when the start button is pushed.	1. Check the circuit breaker (CB7). Reset if tripped. 2. Make sure the Run/Stop switch is in the "RUN" position. 3. Check for loose or faulty battery cable connections. 4. The battery may be low or faulty. 5. The Start button may be faulty.	1. If the battery is replaced or tests good, then the charging circuit may be faulty. Perform the ***Flywheel Alternator Test.*** 2. The starter motor or starter solenoid may be faulty. 3. The engine may be hard to crank due to a mechanical failure in the engine.
The engine cranks but will not start.	1. Check for adequate fuel supply. 2. Check for adequate oil level. 3. The battery voltage may be too low. 4. The fuel filter may be clogged or the fuel contaminated. Replace the fuel filter if necessary.	1. The oil pressure switch may be faulty. See the Wiring Diagram. 2. The engine may be in need of mechanical repair. Check for spark and fuel.
The engine will not develop full power.	1. The fuel filter may be clogged or the fuel contaminated. Replace the fuel filter if necessary. 2. The air filter may be clogged. Replace if necessary. 3. The spark plug(s) may be faulty. Replace if necessary.	1. Due to wear, the engine may need major repair.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine shuts down shortly after starting.	1. Check for adequate fuel supply and a clean fuel filter. 2. Low oil level. Fill to proper level. Start engine and look for leaks. 3. Check the battery cables for loose or faulty connections.	1. Check the RUN/STOP switch and associated leads for loose or faulty connections. 2. The oil pressure switch may be faulty. Replace if necessary.
The engine will not idle down to low speed. The machine has normal weld output and auxiliary power.	1. Make sure the IDLER switch is in the "AUTO" position. 2. Make sure there is NOT an external load on the weld terminals or the auxiliary power receptacles. 3. Check for mechanical restrictions in the idler solenoid linkage.	1. Check leads #210C and 215 for loose or faulty connections. See the Wiring Diagram. 2. Perform the ***Idler Solenoid Test.*** 3. The Control Board may be faulty.
The engine will not go to high idle when using the auxiliary power. Auxiliary power is normal when the IDLER switch is in the "HIGH" position. Automatic idle function works properly when the welding terminals are loaded.	1. Make sure the auxiliary power leads are tight. 2. The automatic idler may not function if the auxiliary power is loaded to less than 100 watts.	1. Make sure leads #3 and #6 pass through the toroid twice in opposite directions. See the Wiring Diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine will not go to high idle when attempting to weld or when the auxiliary power is loaded. Welding output and auxiliary power outputs are normal when IDLER switch is in the " HIGH" position.	1. Make sure the welding cables and auxiliary power lead connections are tight.	1. Check the Current Sensing Toroid leads for loose or faulty connections. See the Wiring Diagram. 2. The Current Sensing Toroid may be faulty. 3. The Control Board may be faulty.
The machine goes to low idle but does not stay at low idle.	1. Make sure there is NOT an external load (auxiliary or weld) connected to the Ranger 250.	1. The idler solenoid linkage may be misadjusted or damaged. 2. The idler solenoid lead connections (#210C and #215) may be loose or damaged. 3. Perform the ***Idler Solenoid Test.*** 4. The Control Board may be faulty.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
The welding arc is “cold.” The engine runs normally. The auxiliary power is normal.	1. Check for loose or faulty connections at the weld output terminals and welding cable connections. 2. The welding cables may be too long or coiled, causing an excessive voltage drop. 3. Make sure the electrode (wire, gas, voltage, current etc.) is correct for the process being used.	1. Check for the correct OCV at the welding output terminals. If the correct voltage is present at the output terminals, check for loose connections on the heavy current carrying leads inside the Ranger 250. See the Wiring Diagram. 2. If the OCV is low at the welder output terminals, perform the ***Engine Throttle Adjustment Test.*** 3. Perform the ***Output Rectifier Bridge Test.*** 4. Perform the ***Stator Voltage Test.*** 5. Perform the ***Power Module Test.*** 6. The Control Board may be faulty.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353.

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CASE COVER REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the case sheet metal cover and engine access doors.

MATERIALS NEEDED

3/8" Wrench or socket wrench
9/16" Wrench

This procedure should take approximately 15 minutes to perform.

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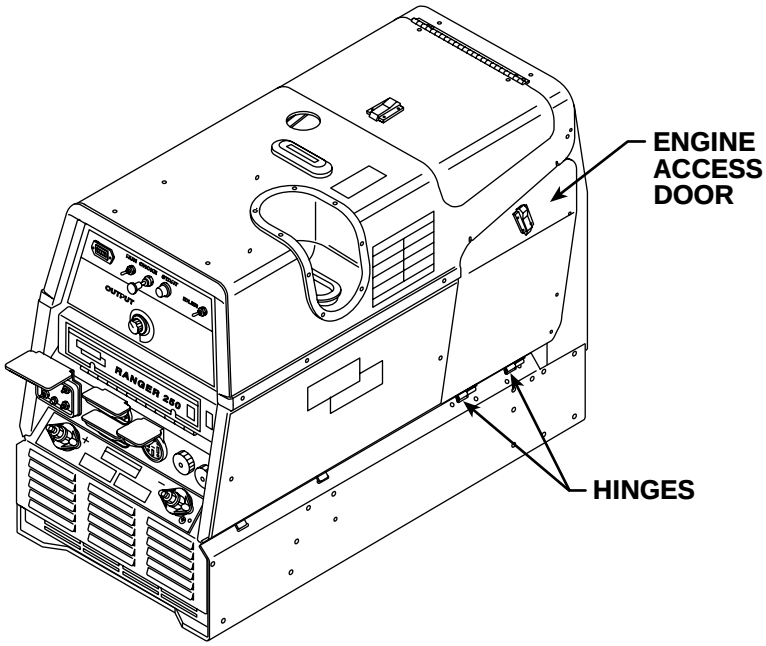
CASE COVER REMOVAL AND REPLACEMENT PROCEDURE *(continued)*

FIGURE F.1 – DOOR REMOVAL



REMOVAL PROCEDURE

1. Turn the engine off.
2. Unlatch and open the engine service access doors.
3. For each door, lift up on the stop pin and slide the door off the hinge. It may be necessary to lightly tap the door with a rubber mallet to free it from the hinge. See Figure F.1.
4. Using the 9/16" wrench, remove the exhaust pipe extension.
5. Remove the cover seal from around the lift bail.
6. Using the 3/8" wrench, remove the sheet metal and machine screws holding the case cover in place.
7. Using the 3/8" wrench, remove the sheet metal screws from the right and left case sides. Tilt each side back and lift up to free the bottom tabs from their slots.
8. Lift the case cover off the machine.

NOTE: It is not necessary to remove the gas cap in order to take the case cover off the machine. Leave the gas cap on when working on the Ranger 250.

REPLACEMENT PROCEDURE

1. Install the right and left case sides and screw them in place.
2. Carefully set the case cover in place. Replace the lift bail cover seal.
3. Install the exhaust pipe extension.
4. Install the screws that hold the case cover in place.
5. Install the doors by lifting the stop pins and sliding each door onto its hinges.
6. Close and latch the doors.

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POWER MODULE CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This procedure will insure that the large capacitors in the power module have been discharged. This procedure should be performed whenever work is to be attempted on or near the power module.

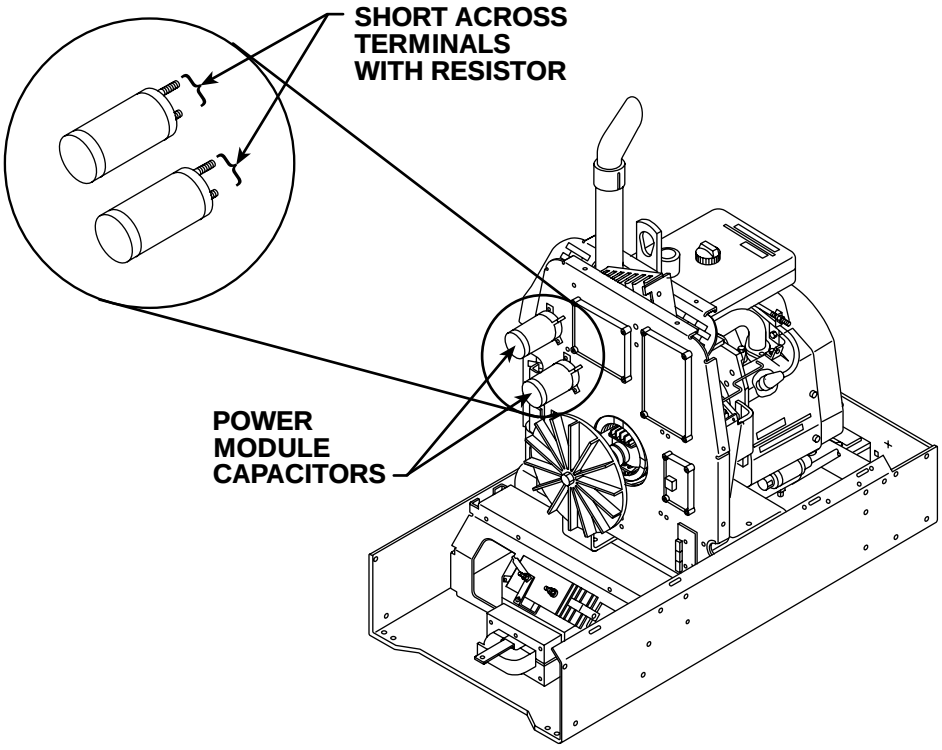
MATERIALS NEEDED

3/8" Wrench or socket wrench
9/16" Wrench
Volt/Ohmmeter
Resistor (25-1000 ohms and 25 watts minimum)
Jumper leads

This procedure should take approximately 20 minutes to perform.

POWER MODULE CAPACITOR DISCHARGE PROCEDURE *(continued)*

FIGURE F.2 – POWER MODULE CAPACITOR TERMINAL DISCHARGE



TEST PROCEDURE

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.

NOTE: It is not necessary to remove the gas cap in order to take the case cover off the machine. Be sure the gas cap is ON when discharging the power module capacitors.

3. Locate the power module capacitors on the left side of the inner machine baffle. See Figure F.2.
4. Using the resistor and jumper leads, CAREFULLY discharge the capacitor terminals. **NEVER USE A SHORTING STRAP FOR THIS PURPOSE.** DO NOT TOUCH THE TERMINALS WITH YOUR BARE HANDS. Repeat the procedure for the second capacitor.
5. Using the volt/ohmmeter, check the voltage across the capacitor terminals. It should be zero volts.

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IDLER SOLENOID TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the idler solenoid is capable of functioning when it is energized with 12VDC.

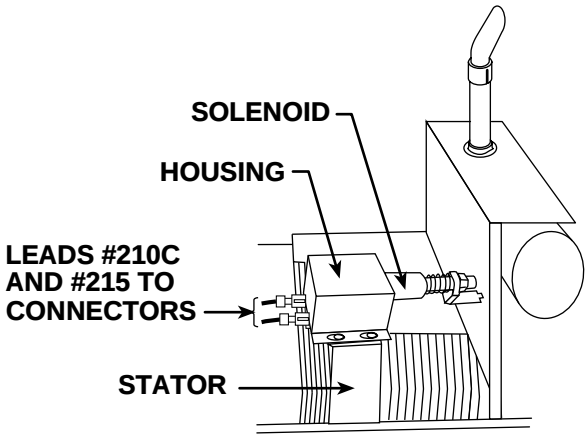
MATERIALS NEEDED

3/8" Wrench or socket wrench
9/16" Wrench
External 12VDC supply (30 amps)
Diagonal cutters
Wiring Diagram
Volt/Ohmmeter

This procedure should take approximately 30 minutes to perform.

IDLER SOLENOID TEST *(continued)*

FIGURE F.3 – IDLER SOLENOID LEADS



TEST PROCEDURE

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.
3. Locate the idler solenoid mounted on the stator beside the fuel tank filler neck.
4. Locate and remove the two in-line connectors that attach the idler solenoid leads to the wiring harness leads (#210C and #215). Cut any necessary cable ties. See Figure F.3 and the Wiring Diagram.
5. Check the coil resistance. The normal resistance is approximately 15 ohms. If the coil resistance is not correct, the solenoid may be faulty. Replace.
6. Using the external 12VDC supply, apply 12VDC to the solenoid leads. Push the solenoid plunger in (this simulates the action that takes place when the engine is running and there is less resistance to solenoid movement) and check that it holds by itself. The solenoid should deactivate when the 12VDC is removed.
7. If the solenoid does not operate properly, check for a mechanical restriction in the linkage. Also check for proper operation of the governor. See the Engine Owner's Manual.
8. If the linkage is intact and the solenoid does not operate correctly when the 12VDC is applied, the solenoid may be faulty. Replace.
9. Replace leads #210C and #215 to the correct in-line connectors. See Figure F.3 and the Wiring Diagram. Replace any previously removed cable ties.
10. If finished testing, perform the ***Case Cover Replacement*** procedure.

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ENGINE THROTTLE ADJUSTMENT TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

If the machine output is low or high, this test will determine whether the engine is operating at the correct speed (RPM) during both HIGH and LOW idle conditions. You can check RPM using a strobe-tach, a frequency counter, an oscilloscope or a vibratach. Directions for adjusting the throttle to the correct RPM are given.

MATERIALS NEEDED

3/8" Wrench or socket wrench
9/16" Wrench
White or red marking pencil
Stobe-tach, frequency counter, oscilloscope, or vibratach

This procedure should take approximately 35 minutes to perform.

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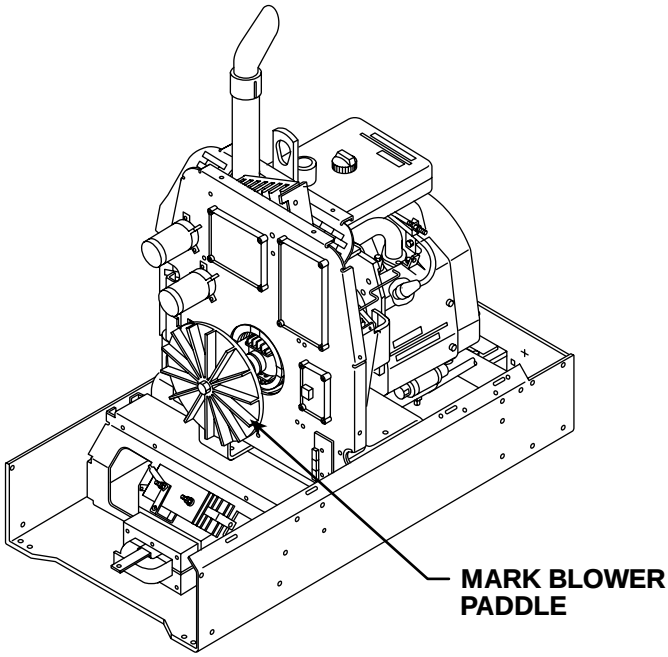
ENGINE THROTTLE ADJUSTMENT TEST *(continued)*

FIGURE F.4 – STROBE MARK LOCATION



TEST PROCEDURE

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.

Strobe-Tach Method

1. With a white or red marking pencil, place a mark on one of the blower paddles. See Figure F.4 for location.
2. Connect the strobe-tach according to the manufacturer's instructions.
3. Start the engine and direct the strobe-tach light on the blower paddle. Synchronize it to the rotating mark.

With the machine at HIGH IDLE the tach should read between 3700 and 3750 RPM.

With the machine at LOW IDLE the tach should read between 2350 and 2450 RPM.

4. If either of the readings is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 3/8" wrench to loosen the spring-loaded adjustment nut. See ***Figure F.5*** for location of the adjustment nut. Turn the nut clockwise to increase the HIGH IDLE speed. Adjust the speed until the tach reads between 3700 and 3750 RPM.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 7/16" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See ***Figure F.6*** for the location of the adjustment nut. Adjust the nut until the tach reads between 2350 and 2450 RPM.

ENGINE THROTTLE ADJUSTMENT TEST *(continued)*

FIGURE F.5 – HIGH IDLE ADJUSTMENT

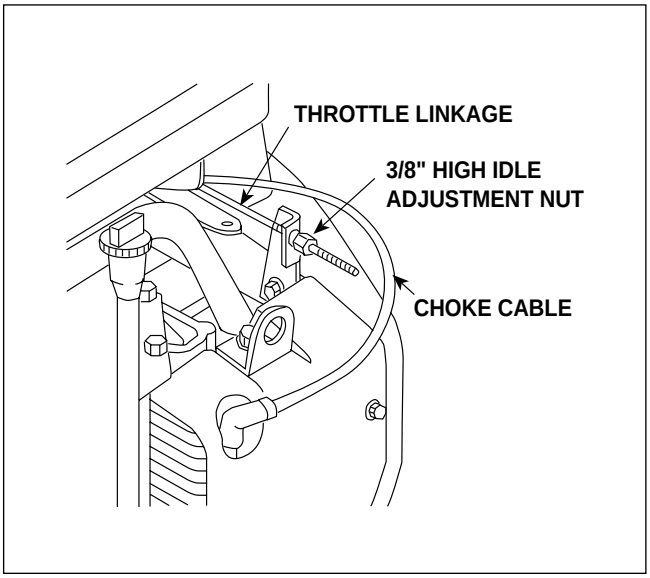
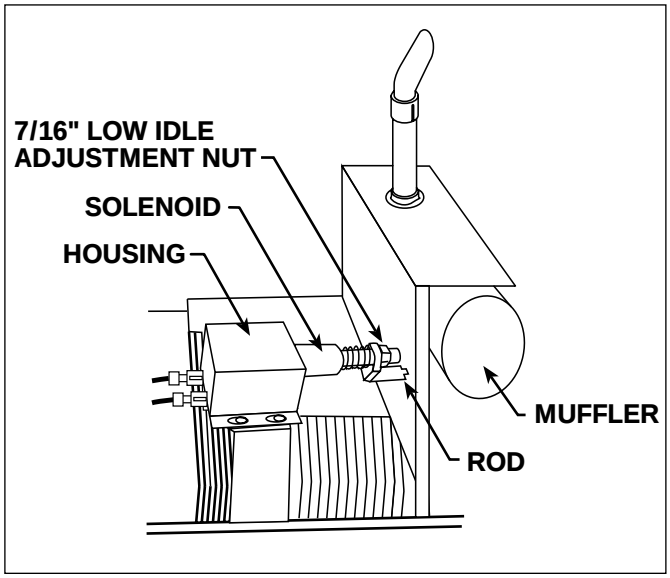


FIGURE F.6 – LOW IDLE ADJUSTMENT



Frequency Counter Method

1. Plug the frequency counter into one of the 120 VAC auxiliary receptacles.
2. Start the engine and check the frequency counter. At HIGH IDLE (3700 RPM), the counter should read between 61 and 63 Hz. At LOW IDLE (2400 RPM), the counter should read between 39 and 40 Hz. Note that these are median measurements; hertz readings may vary slightly above or below.
3. If either of the readings is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 3/8" wrench to loosen the spring-loaded adjustment nut. See Figure F.5 for location of the adjustment nut. Turn the nut clockwise to increase the HIGH IDLE speed. Adjust the speed until the frequency reads between 61 and 63 Hz.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 7/16" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See Figure F.6 for the location of the adjustment nut. Adjust the nut until the frequency reads between 39 and 40 Hz.

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ENGINE THROTTLE ADJUSTMENT TEST *(continued)*

Oscilloscope Method

1. Connect the oscilloscope to the 120 VAC receptacle, according to the manufacturer's instructions. At HIGH IDLE (3700 RPM), the waveform should exhibit a period of 16.2 milliseconds. At LOW IDLE (2400 RPM), the waveform should exhibit a period of 25.0 milliseconds. Refer to the ***NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (120 VAC SUPPLY) HIGH IDLE - NO LOAD*** in this section of the manual.
2. If either of these waveform periods is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 3/8" wrench to loosen the spring-loaded adjustment nut. See ***Figure F.5*** for location of the adjustment nut. Turn the nut clockwise to increase the HIGH IDLE speed. Adjust the speed until the period is 16.2 milliseconds.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 7/16" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See ***Figure F.6*** for the location of the adjustment nut. Adjust the nut until the period is 25.0 milliseconds.

Vibratach Method

1. Place the vibratach as close to the engine as possible. With the machine case top removed, the top of the air cleaner is the best location.
2. Start the engine and observe the whip handle of the vibratach. At HIGH IDLE (3700 RPM), the whip handle should exhibit maximum oscillation. At LOW IDLE (2400 RPM), the whip handle should exhibit minimum oscillation. Note that these are median measurements; vibratach readings may vary slightly above or below.
3. If either of the vibratach indications is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 3/8" wrench to turn the spring-loaded adjustment nut. See ***Figure F.5*** for location of the adjustment nut. Turn the nut clockwise to increase HIGH IDLE speed. Adjust the speed until the vibratach whip handle exhibits maximum oscillation at 3650 to 3750 RPM.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 7/16" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See ***Figure F.6*** for location of the adjustment nut. Adjust the speed until the vibratach whip handle exhibits minimum oscillation at 2350 to 2450 RPM.

When finished testing, perform the ***Case Cover Replacement*** procedure.

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ROTOR RESISTANCE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there is an open winding in the rotor or if the rotor is grounded.

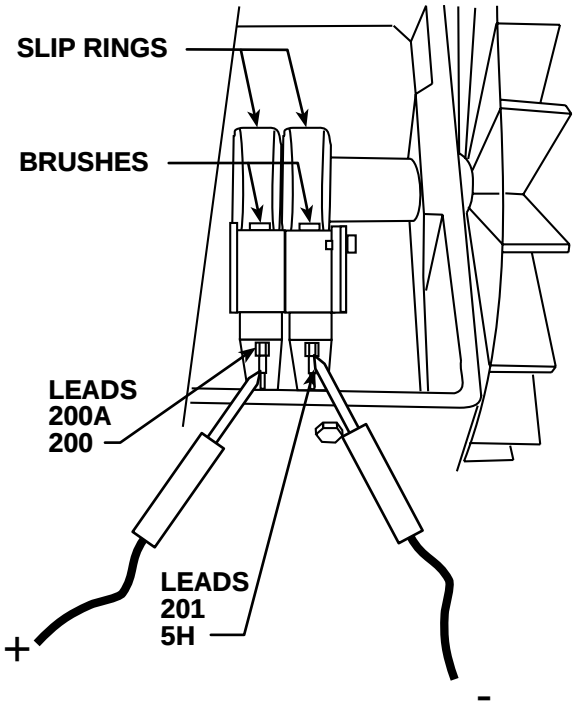
MATERIALS NEEDED

Ohmmeter
3/8" Wrench or socket wrench
7/16" wrench
9/16" Wrench
Needle nose pliers
Wiring Diagram

This procedure should take approximately 30 minutes to perform.

ROTOR RESISTANCE TEST *(continued)*

FIGURE F.7 – ROTOR BRUSH LEADS



TEST PROCEDURE

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.
3. Locate and label the four leads from the rotor brush holder assembly. See Figure F.7. Using the needle nose pliers, remove the leads. See Figure F.7. This will electrically isolate the rotor windings.
4. Using the ohmmeter, check the rotor winding resistance across the slip rings. See Figure F.7. Normal resistance is approximately 4.7 ohms.
5. Measure the resistance to ground. Place one meter probe on either of the slip rings. Place the other probe on any good unpainted ground. The resistance should be very high, at least 500,000 ohms.
6. If the test does not meet the resistance specifications, then the rotor may be faulty. Replace.
7. Connect the leads previously removed from the brush assembly. Make sure the leads are connected to the proper brushes. See the Wiring Diagram.
8. If finished testing, perform the ***Case Cover Replacement*** procedure.

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FLASHING AND ROTOR VOLTAGE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the correct DC voltage is being applied to the rotor at the maximum engine speed (3700 RPM). This information will aid the technician in determining if the generator field is operating properly. Tests can be conducted with the engine stopped (static test) and running (dynamic test). These procedures also allow you to test the oil pressure switch for proper functioning.

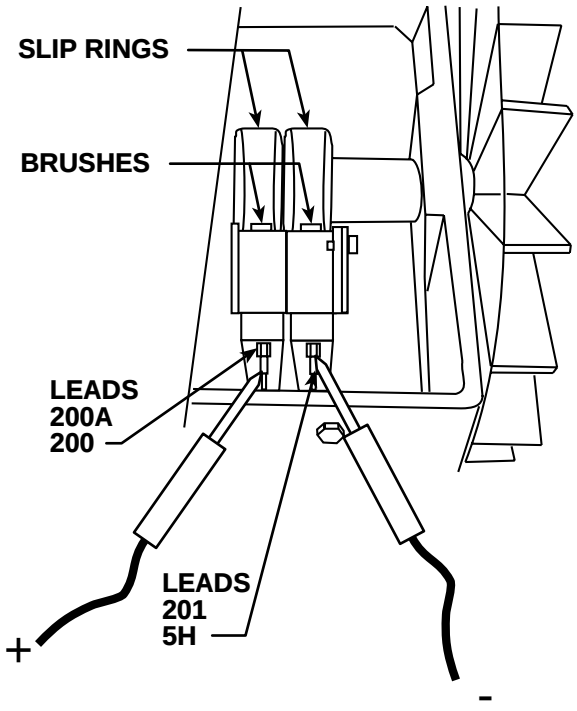
MATERIALS NEEDED

3/8" Wrench or socket wrench
9/16" Wrench
Test pins
Jumper lead
Volt/Ohmmeter
Wiring Diagram

This procedure should take approximately 35 minutes to perform.

FLASHING AND ROTOR VOLTAGE TEST *(continued)*

FIGURE F.8 – ROTOR BRUSH LEADS



TEST PROCEDURE

1. Perform the ***Case Cover Removal*** procedure.
2. Set the volt/ohmmeter to the DC volts position.
3. Test rotor voltage - static (engine stopped but running condition simulated):
   a. Connect a jumper between P51 leads #210 and #224. See the Wiring Diagram. This bypasses the oil pressure switch and simulates the test with the engine running.
   b. Remove the spark plug wires, then set the RUN/STOP switch to RUN.
   c. Connect the positive meter probe to the brush nearest the rotor lamination (leads #200A and #200). See Figure F.8 for location.
   d. Connect the negative meter probe to the other brush (leads #201 and #5H).
   e. Measure the voltage. It should read between 3.0 and 4.0 VDC.
   f. Set the RUN/STOP switch to STOP.

Oil Pressure Switch Test

The oil pressure switch is designed to open if it detects low or no oil pressure. If you can conduct the test described here in Step 3 and obtain the 3.0 to 4.0 VDC voltage reading, WITHOUT THE JUMPER, then the oil pressure switch or the Battery PC board may be faulty.

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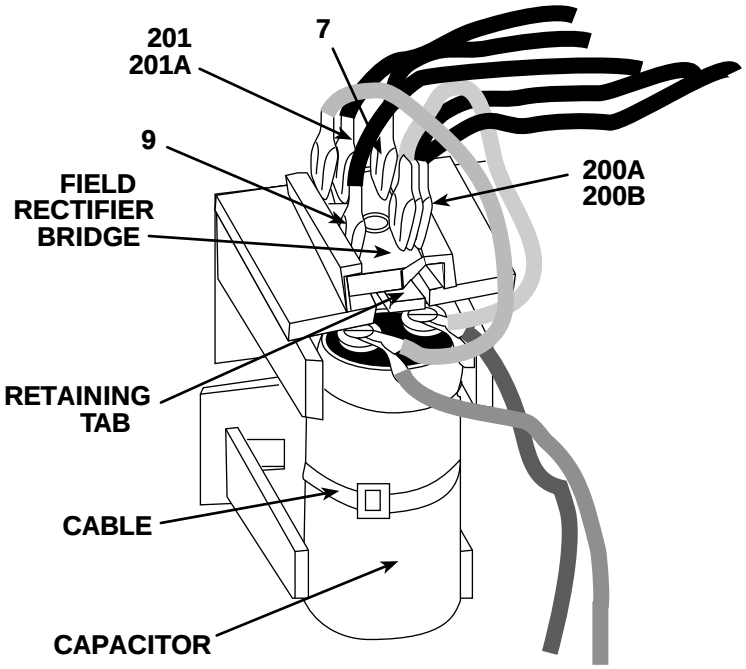
FLASHING AND ROTOR VOLTAGE TEST *(continued)*

FIGURE F.9 – FIELD DIODE RECTIFIER BRIDGE AND FILTER CAPACITOR



4. Test rotor voltage - dynamic (engine running)

   a. Remove the jumper used in the previous step. Replace the spark plug wires, set the RUN/STOP switch to RUN, start the engine and run it at high idle speed (3700 RPM).

   b. Connect the positive meter probe to the brush nearest the rotor lamination (leads #200A and #200). See ***Figure F.8*** for location.

   c. Connect the negative meter probe to the other brush (leads #201 and #5H).

   d. Carefully measure the voltage. It should read approximately 46 - 52 VDC.

5. If the voltage reading is low or not present, the generator field is not functioning properly. Perform the ***Rotor Resistance Test.*** Also check the field diode rectifier bridge, filter capacitor, and associated leads and connections. See Figure F.9 for location. See the Wiring Diagram.

6. Check the rotor ground wire #5H for good connection. See the Wiring Diagram.

7. If the rotor voltage readings are normal, the field circuit is functioning properly.

8. If finished testing, perform the ***Case Cover Replacement*** procedure.

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STATOR VOLTAGE TESTS

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the correct AC voltages are being generated from the stator windings.

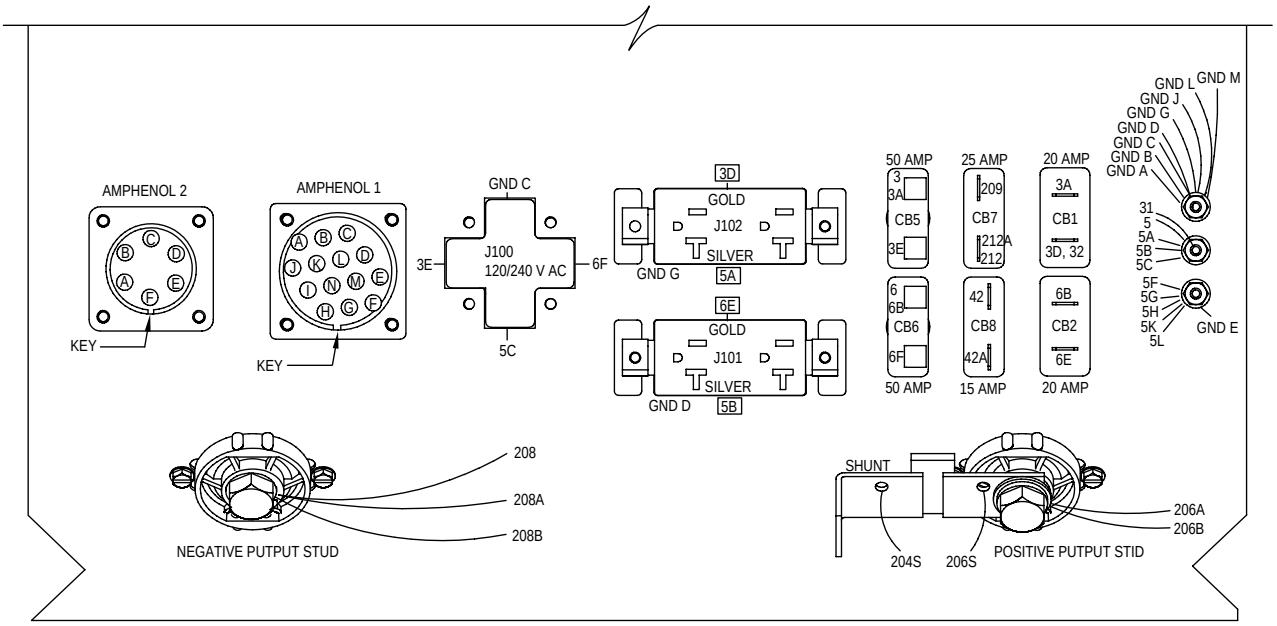
MATERIALS NEEDED

3/8" Wrench or socket wrench
9/16" Wrench
3/4" Wrench
Test pins
Volt/Ohmmeter
Wiring Diagram

This procedure should take approximately 40 minutes to perform.

STATOR VOLTAGE TESTS *(continued)*

FIGURE F.10 – RECEPTACLE LEAD LOCATIONS



CASE FRONT - REAR VIEW

TEST PROCEDURE

For all tests: Perform the ***Case Cover Removal*** procedure.

To test the 120 VAC winding:

1. Connect the volt/ohmmeter probes to either 120 VAC receptacle as follows. See Figure F.10 and the Wiring Diagram.

   Upper receptacle, to leads #3D and #5A. Lower receptacle, to leads #6E and 5B.

NOTE: It is easier to insert the probes directly into the receptacle to perform this test. However, the probes may not reach in far enough to make or keep a good connection. In this case, before you start the engine, insert two test pins into the receptacle. Hold the test probes against these inserts to measure voltage (Step 3).

2. Start the engine and run it at high idle (3700 RPM).
3. Check the AC voltage reading. It should read between 118 and 126 VAC.

To test the 240 VAC winding:

1. Connect the volt/ohmmeter probes to leads #6F and #3E where they connect to the 240VAC receptacle.

NOTE: It is easier to insert the probes directly into the receptacle to perform this test. However, the probes may not reach in far enough to make or keep a good connection. In this case, before you start the engine, insert two test pins into the receptacle. Hold the test probes against these inserts to measure voltage (Step 3).

2. Start the engine and run it at high idle (3700 RPM).
3. Check the AC voltage reading. It should read between 236 and 252 VAC.

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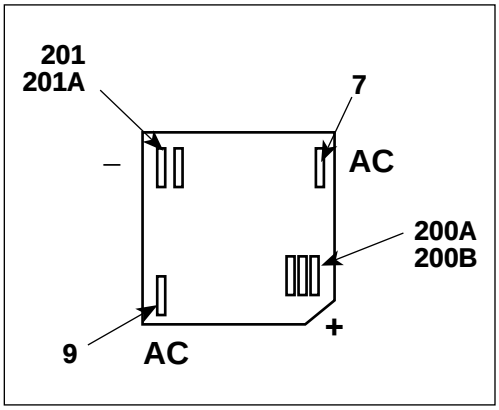
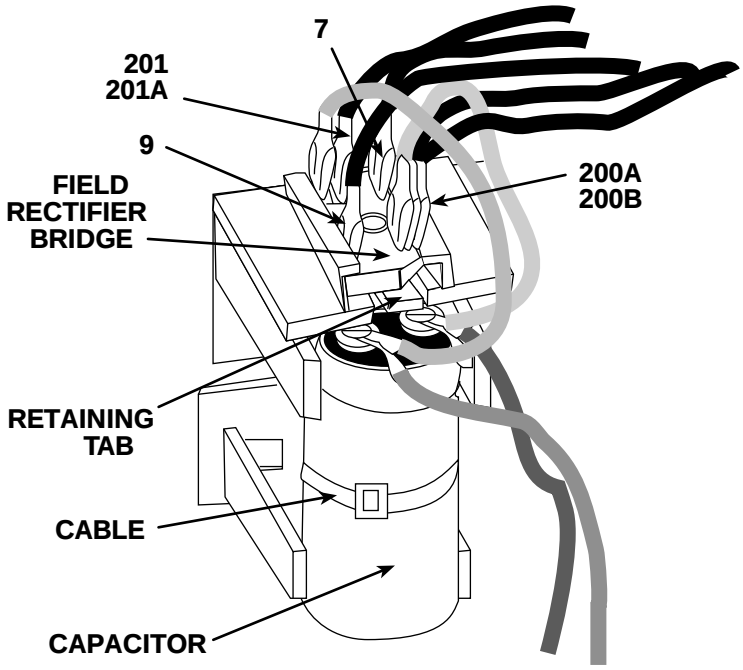
STATOR VOLTAGE TESTS *(continued)*

FIGURE F.11 – LOCATION OF LEADS #7 AND #9 AT FIELD DIODE RECTIFIER BRIDGE





To test the field winding:

1. Connect the volt/ohmmeter probes to leads #7 and #9 where they connect to the field diode rectifier bridge. See Figure F.11.
2. Start the engine and run it at high idle (3700 RPM).
3. Check the AC voltage reading. It should be between 40 and 50 VAC.

If any one or more of the readings are missing or not within specifications, check for loose or broken wires between the test points and the stator windings. See the Wiring Diagram. Make sure that the windings are NOT grounded internally to the stator iron. If the leads are intact, then the stator may be faulty. Replace the stator.

If the voltage readings are within specifications, then the windings are good and functioning properly.

4. If finished testing, perform the ***Case Cover Replacement*** procedure.

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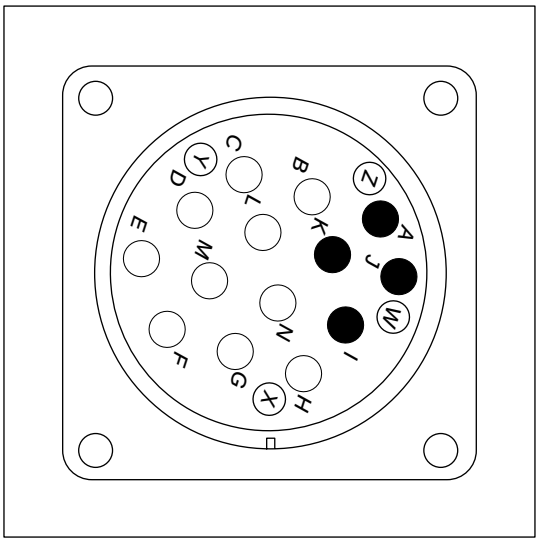
STATOR VOLTAGE TESTS *(continued)*

FIGURE F.12 – 14-PIN AMPHENOL PIN ASSIGNMENTS



To test the feeder winding:

1. Connect the volt/ohmmeter probes to leads #31 and #32 where they connect to circuit breaker CB1 and the 14-pin amphenol. See the Wiring Diagram.

NOTE: It is possible to check this voltage reading at the amphenol by inserting the test probe pins at pin A (for lead #32) and pin J (for lead #31). See Figure F.12. However, if you use this method and you get no voltage reading, it could mean there is a break or loose connection in the leads between the circuit breaker and the amphenol. Check the reading again with one probe at the circuit breaker connection for lead #32 and the other probe at amphenol pin J.

2. Start the engine and run it at high idle (3700 RPM).
3. Check the AC voltage reading. It should be between 118 and 126 VAC.
4. Connect the volt/ohmmeter probes to leads #41A and #42A where they connect to circuit breaker CB8 and the 14-pin amphenol. See the Wiring Diagram.

NOTE: It is possible to check this voltage reading at the amphenol by inserting the test probe pins at pin K (for lead #42A) and pin I (for lead #41A). See Figure F.12. However, if you use this method and you get no voltage reading, it could mean there is a break or loose connection in the leads between the circuit breaker and the amphenol. Check the reading again with one probe at the circuit breaker connection for lead #42A and the other probe at amphenol pin I.

5. Start the engine and run it at high idle (3700 RPM).
6. Check the AC voltage reading. It should be between 40 and 46 VAC.

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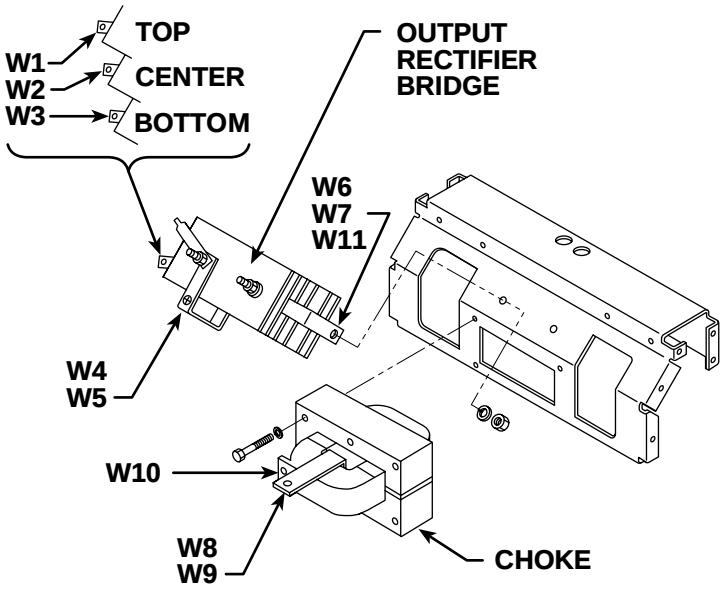
STATOR VOLTAGE TESTS *(continued)*

FIGURE F.13 – OUTPUT RECTIFIER BRIDGE CONNECTIONS



If any one or more of the readings are missing or not within specifications, then check for loose or broken wires between the test points and the stator windings. See the Wiring Diagram. Make sure that the windings are NOT grounded internally to the stator iron. If the leads are intact, then the stator may be faulty. Replace the stator.

If the voltage readings are within specifications, then the windings are good and functioning properly.

7. If finished testing, perform the ***Case Cover Replacement*** procedure.

To test the stator weld windings:

1. Locate the weld winding leads connected to the three-phase output rectifier bridge. See Figure F.13.
2. Check for approximately 58 - 65 VAC from W1 to W2. Also check for the same voltage from W2 to W3 and from W1 to W3.
3. If any of these voltages are low or missing, perform the ***Flashing and Rotor Voltage Test*** and also the ***Rotor Resistance Test.***
4. If the tests in Step 2 are OK and the stator voltages are low or missing, the stator may be faulty.
5. If finished testing, perform the ***Case Cover Replacement*** procedure.

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ANALOG POWER PC BOARD VOLTAGE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if the Analog Power PC board is receiving and passing the proper signal voltages.

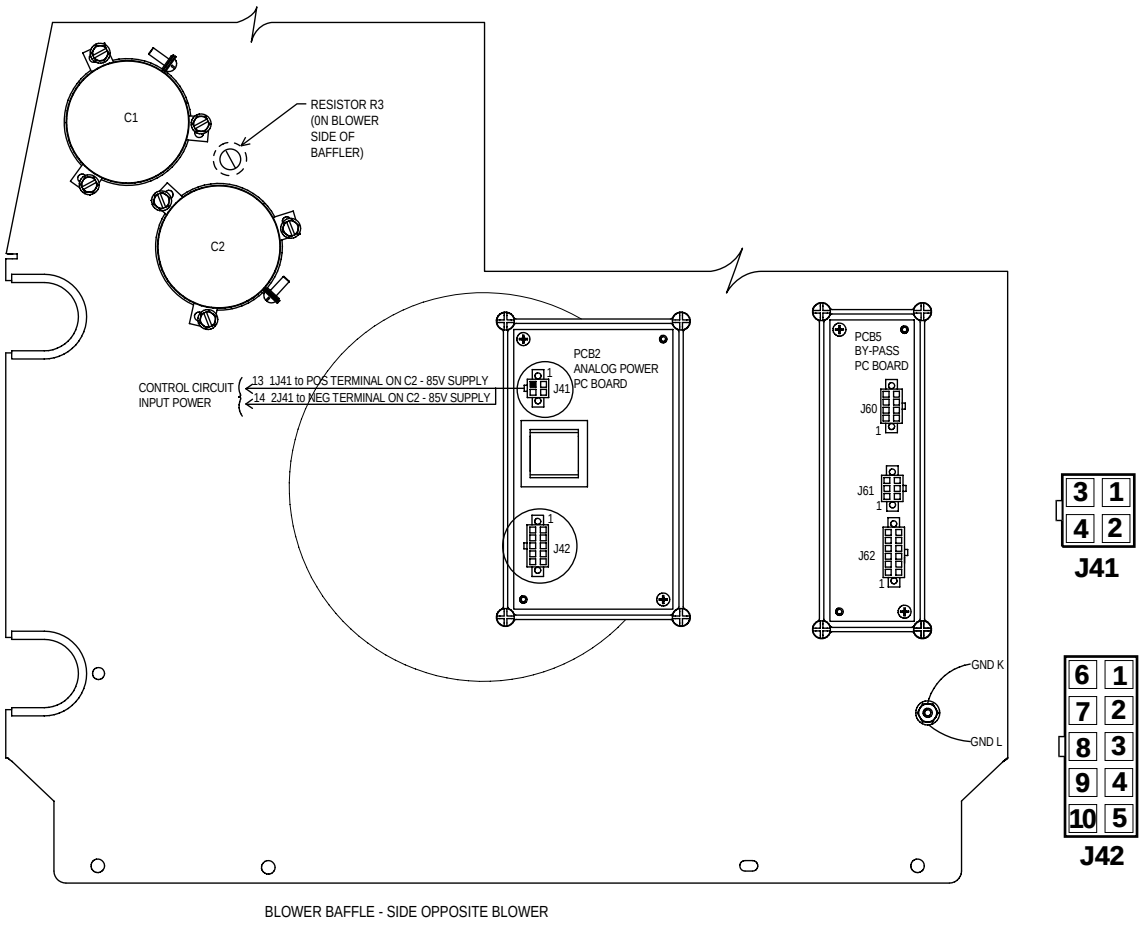
MATERIALS NEEDED

Analog Volt/Ohmmeter
3/8" Wrench or Socket Wrench
9/16" Wrench
Wiring Diagram

This procedure should take approximately 30 minutes to perform.

ANALOG POWER PC BOARD VOLTAGE TEST *(continued)*

FIGURE F.14 – ANALOG POWER PC BOARD



TEST PROCEDURE

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.
3. Locate plugs J41 and J42 from the Analog Power PC board. See Figure F.14.
4. Start the engine and run it at high idle (3700 RPM) with no load.
5. Check for the correct Analog Power PC board input voltage:
   a. Set the volt/ohmmeter to the Volts DC position.
   b. Place the negative probe on J41 pin 2 and the positive probe on J41 pin 1.
   c. The reading should be between 75 and 85 VDC.

If the reading is not correct, the stator output may be incorrect, the rectifier output may be incorrect, the capacitors may be faulty or the Power Module PC board may be faulty. Perform the ***Stator Voltage Test,*** the ***Output Rectifier Bridge Test,*** and the ***Power Module PC Board Test.*** The capacitors C1 and C2 may be faulty. Test and replace if necessary.

6. Check for the correct output voltage readings per ***Table F.1.*** If any of the readings are not correct, the Analog Power PC board may be faulty.

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ANALOG POWER PC BOARD VOLTAGE TEST *(continued)*

TABLE F.1. – ANALOG PC BOARD OUTPUT VOLTAGE TABLE

TEST POINTS	COMPONENT TESTED	VOLTAGE READING
1J42 to 6J42	Chopper Power Supply	**+20 VDC**
2J42 to 7J42	Weld Control PC Board Power Supply	**+5 VDC**
5J42 to 7J42	Weld Control PC Board Power Supply	**+15 VDC**
9J42 to 7J42	Weld Control PC Board Power Supply	**-15 VDC**
10J42 to 4J42	Weld Control PC Board Power Supply	**+15 VDC**

7. If finished testing, perform the ***Case Cover Replacement*** procedure.

NOTE ON THE BYPASS PC BOARD

The purpose of the Bypass PC board circuitry is to provide a more attractive path to ground for transient spikes and high frequency signals that could damage sensitive circuit components. The Ranger 250 Bypass PC board cannot be tested. However, a faulty Bypass PC may show visible physical damage. As a general rule of practice, if you have catastrophic damage to any other PC board on the machine, the Bypass PC board should be replaced as well.

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OUTPUT RECTIFIER BRIDGE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

TEST DESCRIPTION

This test will determine if there are faulty diodes in the output rectifier bridge.

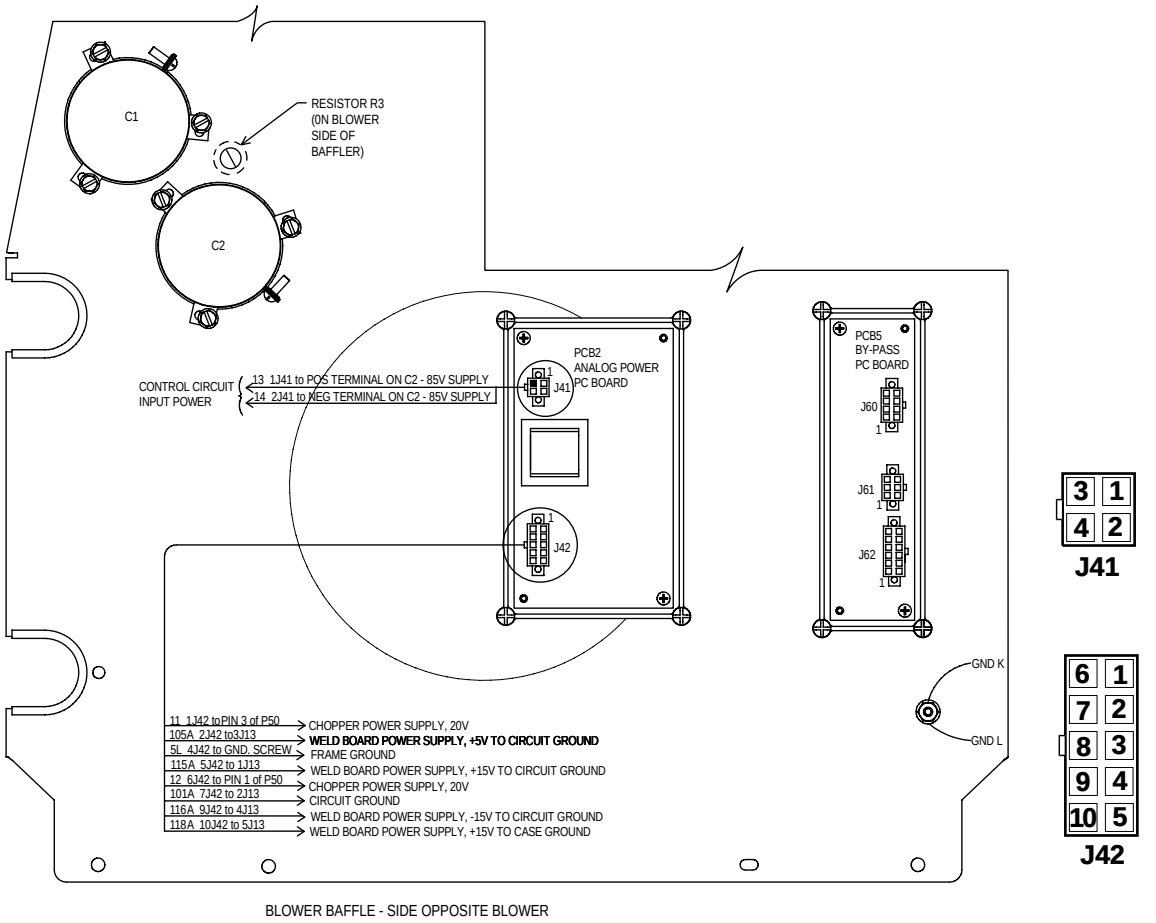
MATERIALS NEEDED

Volt/Ohmmeter (Analog)
11/32" Nut driver
1/2" Wrench
3/8" Wrench or socket wrench
9/16" Wrench
Wiring Diagram

This procedure should take approximately 45 minutes to perform.

OUTPUT RECTIFIER BRIDGE TEST *(continued)*

FIGURE F.15 – PLUG J41 AND RESISTOR R3 LOCATIONS


C1
C2
RESISTOR R3
(0N BLOWER
SIDE OF
BAFFLER)
CONTROL CIRCUIT
INPUT POWER
13 1J41 to POS TERMINAL ON C2 - 85V SUPPLY
14 2J41 to NEG TERMINAL ON C2 - 85V SUPPLY
PCB2
ANALOG POWER
PC BOARD
J41
J42
PCB5
BY-PASS
PC BOARD
J60
J61
J62
GND K
GND L
11 1J42 toPIN 3 of P50 → CHOPPER POWER SUPPLY, 20V
105A 2J42 to3J13 → WELD BOARD POWER SUPPLY, +5V TO CIRCUIT GROUND
5L 4J42 to GND. SCREW → FRAME GROUND
115A 5J42 to 1J13 → WELD BOARD POWER SUPPLY, +15V TO CIRCUIT GROUND
12 6J42 to PIN 1 of P50 → CHOPPER POWER SUPPLY, 20V
101A 7J42 to 2J13 → CIRCUIT GROUND
116A 9J42 to 4J13 → WELD BOARD POWER SUPPLY, -15V TO CIRCUIT GROUND
118A 10J42 to 5J13 → WELD BOARD POWER SUPPLY, +15V TO CASE GROUND
3 1
4 2
J41
6 1
7 2
8 3
9 4
10 5
J42
BLOWER BAFFLE - SIDE OPPOSITE BLOWER

TEST PROCEDURE

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.
3. Perform the ***Power Module Capacitor Discharge*** procedure.
4. Disconnect plug J41 (with leads #13 and #14) from the Analog Power PC board. See Figure F.15.
5. If your machine has resistor R3, with the 11/32" nut driver, disconnect one end of resistor R3, either lead #252 or #253. See Figure F.15.

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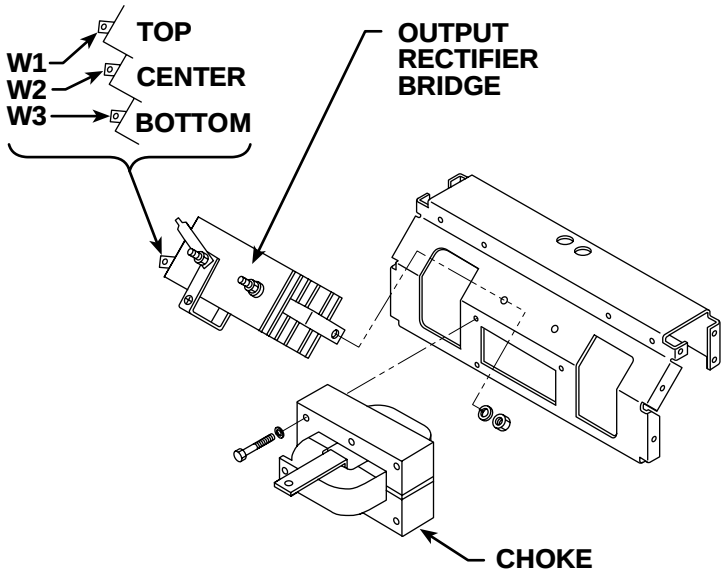
OUTPUT RECTIFIER BRIDGE TEST *(continued)*

FIGURE F.16 – OUTPUT RECTIFIER BRIDGE LEAD REMOVAL AND TEST POINTS



6. Electrically isolate the output rectifier bridge: Using the 1/2" wrench, remove stator leads W1, W2, and W3 from their bolted connections on the left side of the bridge. Note lead placement for reassembly. Bend the leads out into "free air" so that they do not touch anything. See Figure F.16.
7. Remove any load that may be connected to the weld output terminals.
8. Check all diode assemblies individually for opens or shorts. If any of the checks are not correct, the output rectifier bridge may be faulty. See the ***Output Rectifier Bridge Removal and Replacement*** procedure.

When all tests are complete:

1. Replace stator leads W1, W2, and W3 to their respective terminals. Replace lead(s) #252 or #253 previously removed. See Figure F.16.
2. If finished testing, perform the ***Case Cover Replacement*** procedure.

Return to Section TOC
Return to Master TOC

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Return to Master TOC
Return to Section TOC
Return to Master TOC

POWER MODULE TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

This test will help determine if the power module is shorted. This is a resistance test, not a voltage test. This test will only help diagnose a problem in the "power" section of the module. **Other PC board components could be faulty.**

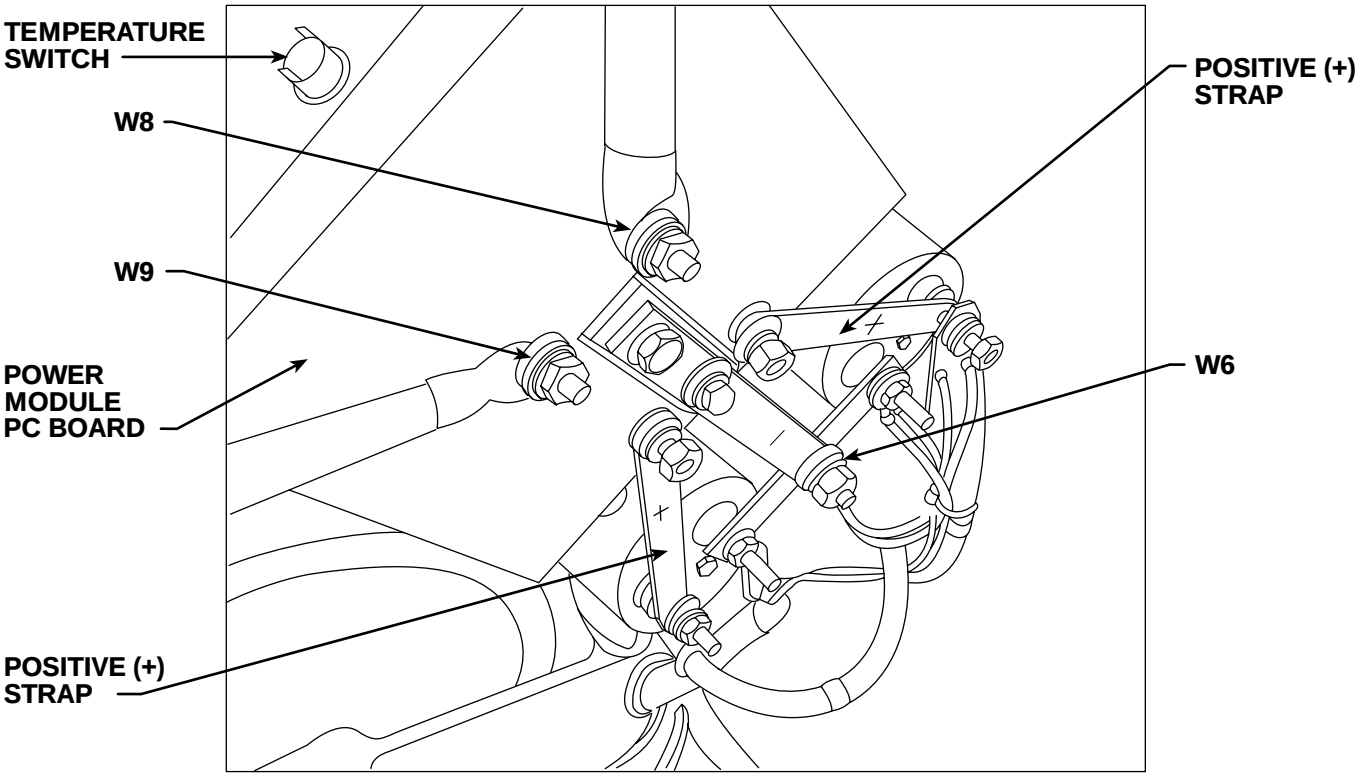
MATERIALS NEEDED

Volt/Ohmmeter (Analog)
3/8" Wrench or socket wrench
9/16" Wrench
1/2" Wrench
7/16" Wrench

This procedure should take approximately 45 minutes to perform.

POWER MODULE TEST *(continued)*

FIGURE F.17 – POWER MODULE CONNECTIONS



TEST PROCEDURE

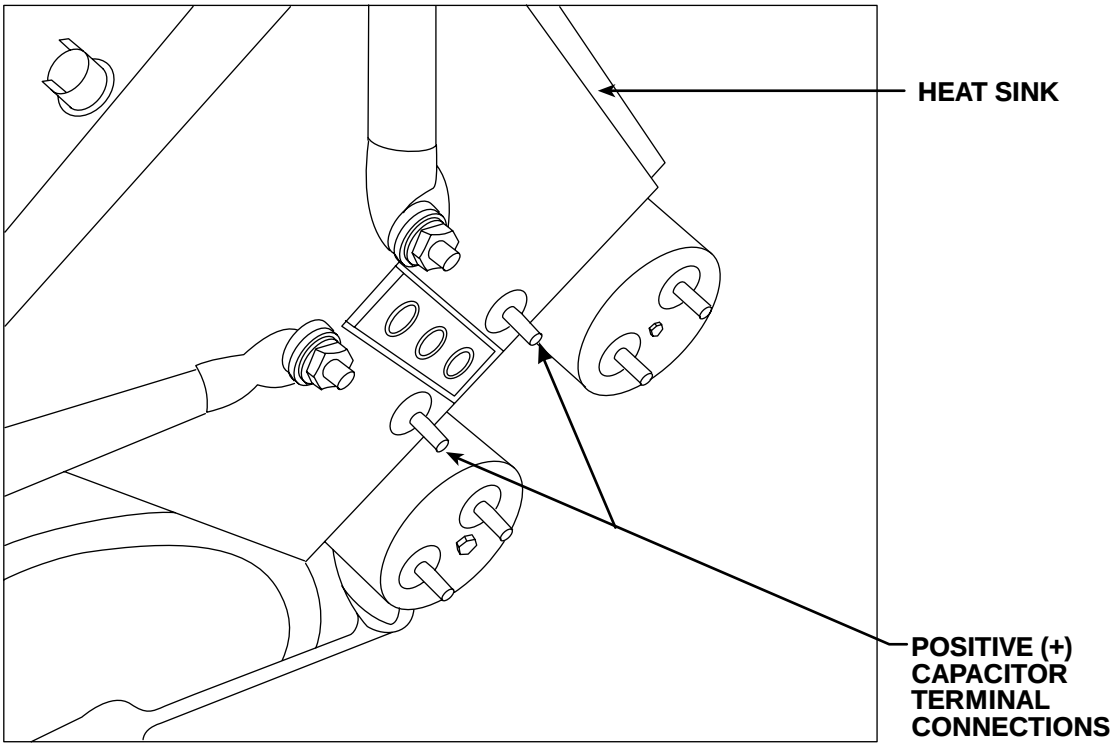
1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.
3. Perform the ***Power Module Capacitor Discharge*** procedure.
4. Using the 7/16" wrench, loosen the nuts on the positive terminals of the power capacitors. Then remove the nuts, lock washers, and flat washers from the terminals where the positive straps connect to the Power Module PC board. Flip the straps out of the way. See Figure F.17.
5. Using the 7/16" wrench, remove the flex leads W8 and W9 from the Power Module PC board terminals.
6. Using the 7/16" wrench, remove the two positive jumper straps attaching the capacitors to the Power Module PC board. Note all lead placements for reassembly. Note lead #253, #13, W4 and W5 do not have to be removed from the circuit. See the Wiring Diagram. The small flex lead connected to D4 should be removed and electrically isolated.
7. Using the 7/16" wrench, remove the W6 lead strap from the power module (two bolted connections). Suggestion: First loosen the straps at the capacitor terminals and remove the nuts on the power module. Then fold the straps back out of the way.

NOTE: Make sure the bolts do not fall back against the heat sink.

Return to Section TOC
Return to Master TOC

POWER MODULE TEST *(continued)*

FIGURE F.18 – IGBT TEST



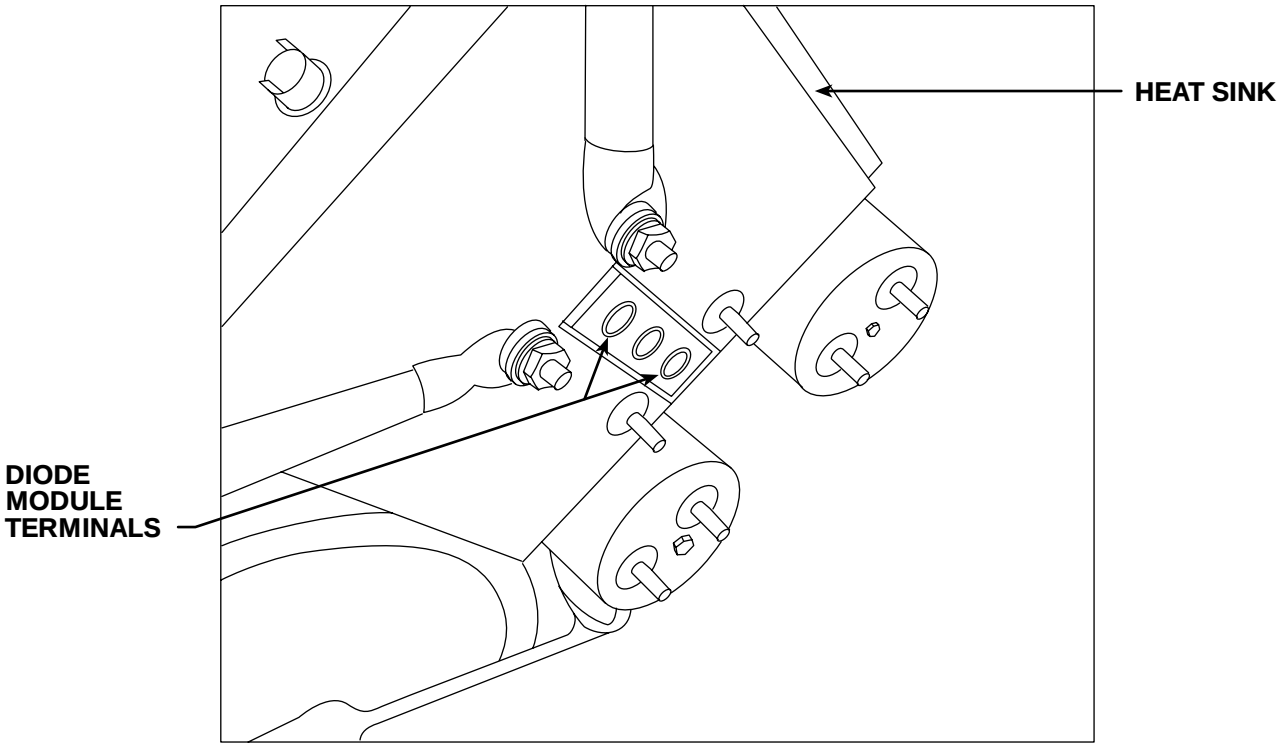
Check IGBT for "Shorts"

8. Using the analog ohmmeter, connect the positive meter probe to the heat sink and the negative meter probe to the positive capacitor terminal **on the power module chopper PC board.** See Figure F.18. The resistance reading should be high (over 20,000 ohms).
9. Reverse the meter probe leads. The resistance should be very high (over 20,000 ohms). It the resistance is low in either Step 8 or 9, the IGBT may be shorted or leaky.

Return to Section TOC
Return to Master TOC

POWER MODULE TEST *(continued)*

FIGURE F.19 – DIODE MODULE TEST



Check Diode Module

10. Using the analog ohmmeter, connect the negative meter probe to the terminal on the diode module. See Figure F.19. Connect the positive meter probe to the heat sink. The resistance should be very high (over 20,000 ohms).
11. Using the analog ohmmeter, connect the positive meter probe to the terminal on the diode module. Connect the negative meter probe to the heat sink. The resistance should be lower (approximately 300 ohms). Also check diode D4 for shorted or open condition. See the Wiring Diagram.

When all tests are complete:

1. Reconnect all leads previously removed.
2. Torque the capacitor nuts to 50-60 inch-pounds.
3. If finished testing, perform the ***Case Cover Replacement*** procedure.

Return to Section TOC
Return to Master TOC

FLYWHEEL ALTERNATOR TEST

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

This test will help determine if the flywheel alternator is properly charging the battery.

MATERIALS NEEDED

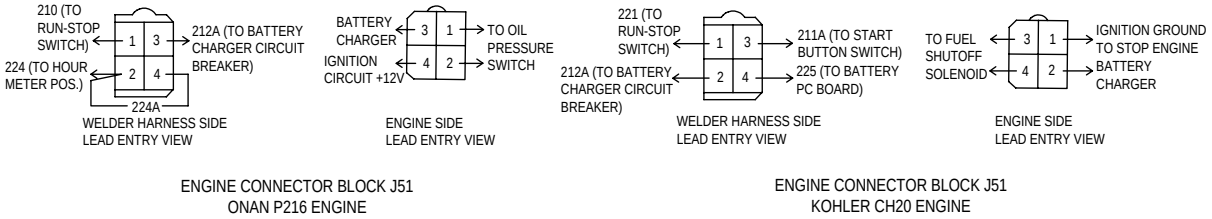
Volt/Ohmmeter
3/8" Wrench or socket wrench

This procedure should take approximately 15 minutes to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

FLYWHEEL ALTERNATOR TEST *(continued)*

FIGURE F.20 – PLUG J51 PIN LOCATION


210 (TO RUN-STOP SWITCH)
224 (TO HOUR METER POS.)
212A (TO BATTERY CHARGER CIRCUIT BREAKER)
224A
WELDER HARNESS SIDE LEAD ENTRY VIEW
BATTERY CHARGER
IGNITION CIRCUIT +12V
TO OIL PRESSURE SWITCH
ENGINE SIDE LEAD ENTRY VIEW
ENGINE CONNECTOR BLOCK J51 ONAN P216 ENGINE
221 (TO RUN-STOP SWITCH)
212A (TO BATTERY CHARGER CIRCUIT BREAKER)
211A (TO START BUTTON SWITCH)
225 (TO BATTERY PC BOARD)
WELDER HARNESS SIDE LEAD ENTRY VIEW
TO FUEL SHUTOFF SOLENOID
IGNITION GROUND TO STOP ENGINE BATTERY CHARGER
ENGINE SIDE LEAD ENTRY VIEW
ENGINE CONNECTOR BLOCK J51 KOHLER CH20 ENGINE

TEST PROCEDURE

1. Turn the engine off.
2. Using the 3/8" wrench, remove the three screws holding the battery access cover in place and slide the battery tray out enough to access the terminals. Using the volt/ohmmeter measure the voltage at the battery terminals. It should be approximately 12 volts DC.
3. Start the engine and run it at high idle for approximately 30 seconds. Measure the voltage at the battery terminals. It should be 13.7 to 14.2 volts DC. If correct, the test is over. If not correct, proceed to the next step.
4. Check circuit breaker CB7 on the front panel. Reset if tripped. Repeat Step 3. If circuit breaker is functioning properly, proceed to Step 5.
5. Perform the ***Case Cover Removal*** procedure.
6. Perform the ***Power Module Capacitor Discharge*** procedure.
7. Locate plug J51 leads 212A (pin 3 or 2) or engine alternator lead pin 3 (C1). See Figure F.20. Check from pin 3 to the negative battery terminal with the engine running at high idle speed (3700 RPM). Normal voltage is 13.7 to 14.2 volts DC. If not correct, the flywheel alternator may be faulty. If correct, check the wiring between the flywheel alternator and the positive battery terminal. See the Wiring Diagram.
8. If finished testing, perform the ***Case Cover Replacement*** procedure.

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
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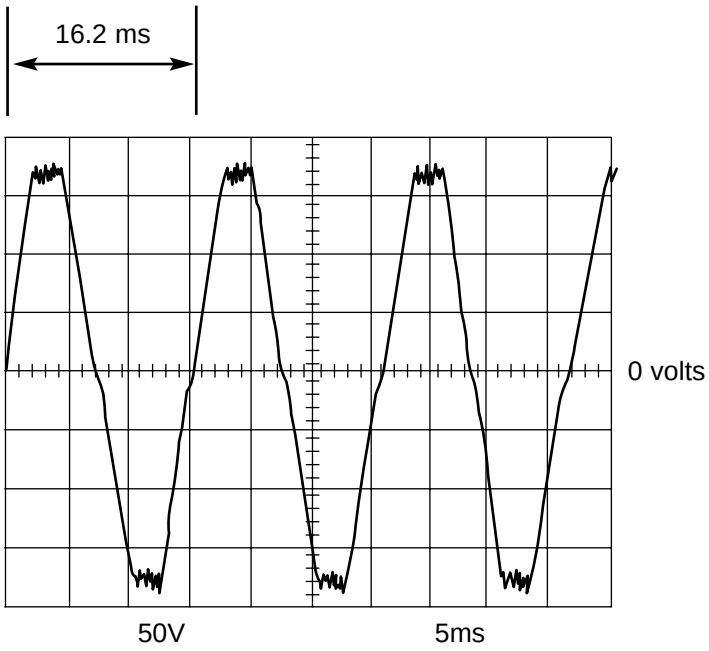
Return to Section TOC
Return to Master TOC

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (120VAC SUPPLY)

HIGH IDLE – NO LOAD



This is the typical auxiliary output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

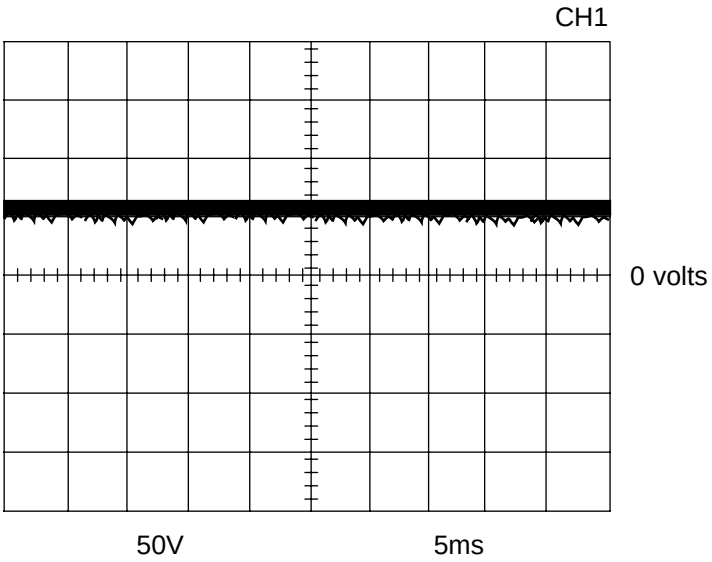
NOTE: Scope probes are connected at machine 120 VAC receptacle.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (STICK)

MAX CONTROL POT - HIGH IDLE - NO LOAD



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

NOTE: Scope probes are connected at weld output terminals.

SCOPE SETTINGS

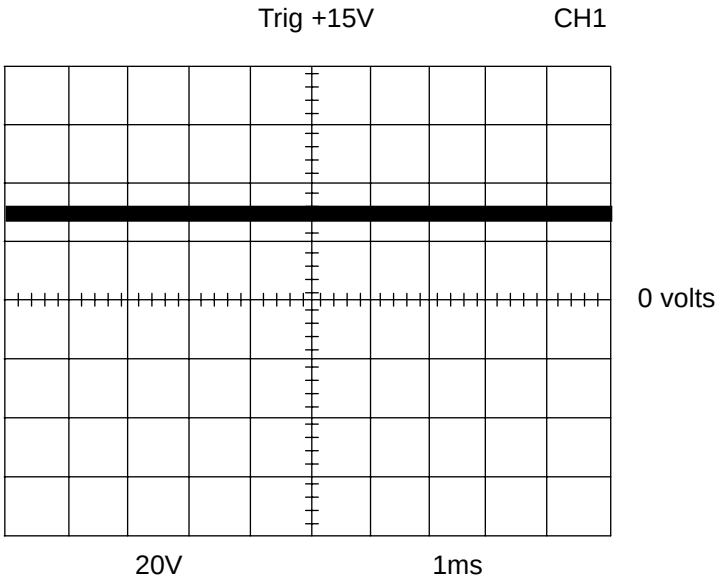
Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

NORMAL WELD VOLTAGE WAVEFORM (STICK CC)

MACHINE LOADED TO 250 AMPS AT 25 VOLTS



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 1 millisecond in time.

The machine was loaded with a resistance grid bank to 250 amps at 25 volts.

NOTE: Scope probes are connected at weld output terminals.

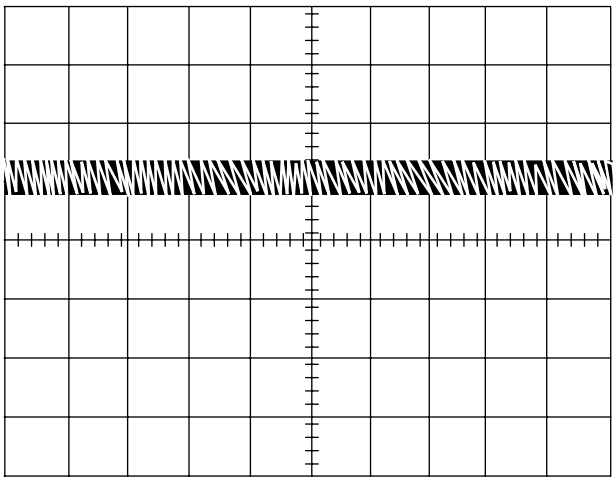
SCOPE SETTINGS

Volts/Div	20V/Div
Horizontal Sweep	1 ms/Div.
Coupling	DC
Trigger	Internal

Return to Section TOC
Return to Master TOC

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (WIRE CV TAP)

MAX CONTROL POT - HIGH IDLE - NO LOAD



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

NOTE: Scope probes are connected at weld output terminals.

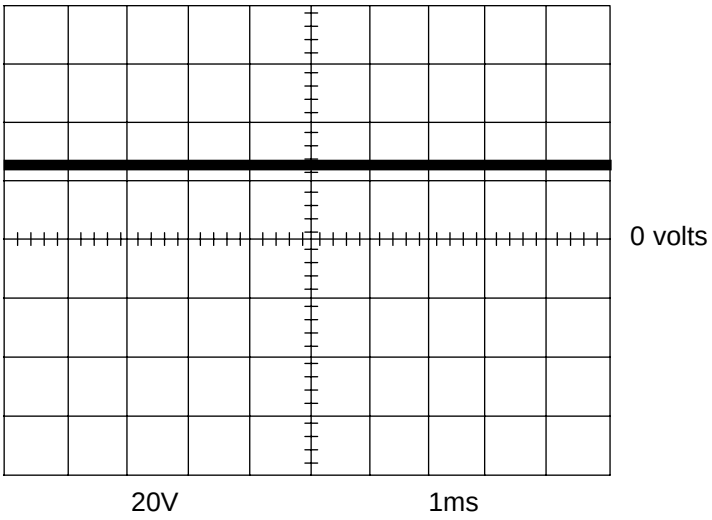
SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

Return to Section TOC
Return to Master TOC

NORMAL WELD VOLTAGE WAVEFORM (WIRE CV)

MACHINE LOADED TO 250 AMPS AT 28 VOLTS



This is the typical DC voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 1 millisecond in time.

The machine was loaded with a resistance grid bank to 250 amps at 28 volts.

NOTE: Scope probes are connected at weld output terminals.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	1 ms/Div.
Coupling	DC
Trigger	Internal

Return to Section TOC
Return to Master TOC

POWER MODULE ASSEMBLY/POWER MODULE PC BOARD/ DIODE MODULE REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-800-833-9353 (WELD).

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Power Module assembly. Procedures for removal and replacement of the Power Module PC board and the diode module are included.

MATERIALS NEEDED

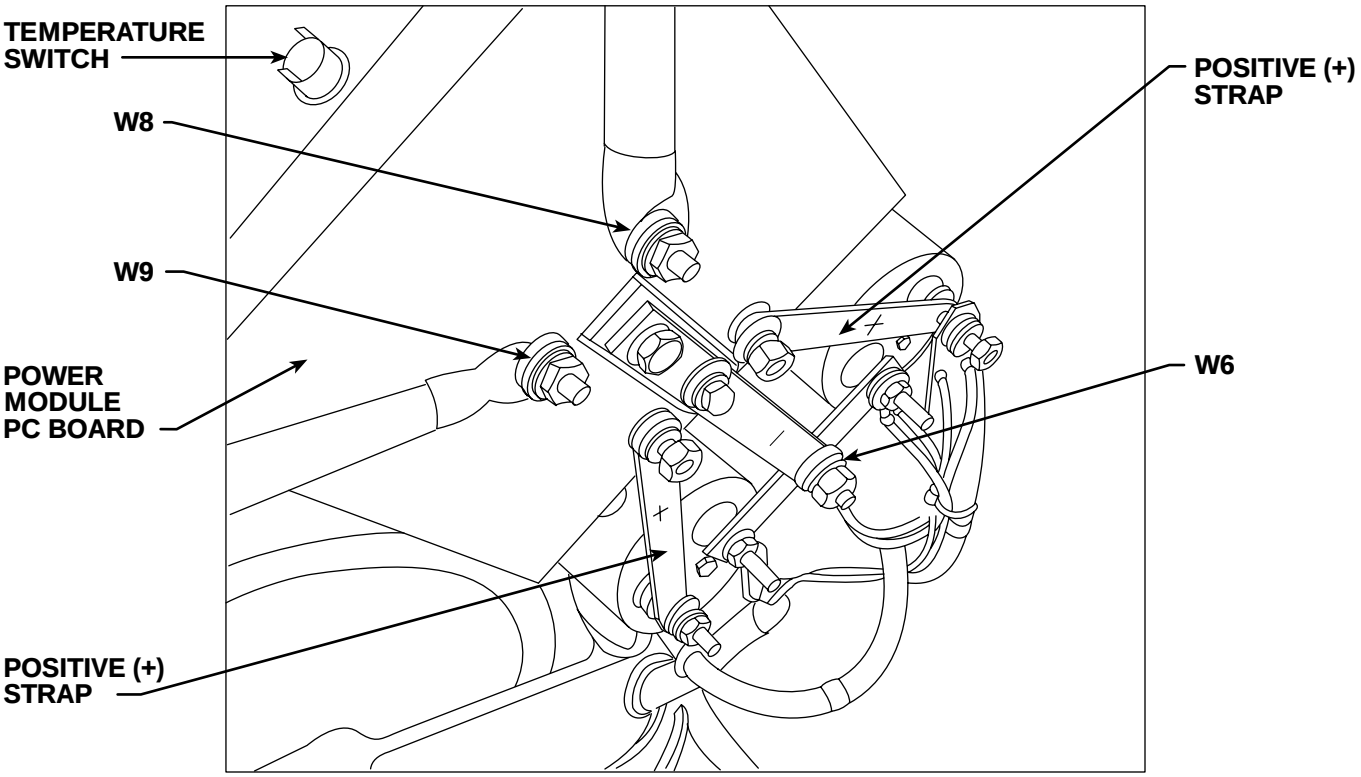
3/8" wrench or socket wrench
7/16" wrench
7/16" Socket wrench
1/2" Wrench
9/16" Wrench
3/16" Allen head wrench
9/64" Allen head wrench
Torque wrench with 3/16" and 9/64" allen head sockets
Phillips head screw driver
Diagonal cutters
Electrical thermal joint compound - Penetrox A-13

This procedure should take approximately 1 hour to perform.

Return to Section TOC
Return to Master TOC

POWER MODULE ASSEMBLY REMOVAL AND REPLACEMENT

FIGURE F. 21 – POWER MODULE CONNECTIONS



PROCEDURE

Removal

Refer to Figures F.21 and ***F.22.***

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.
3. Perform the ***Power Module Capacitor Discharge*** procedure.
4. Label heavy leads W8 and W9 and, using the 7/16" wrench, remove the nuts, lock washers, and flat washers holding them to the Power Module PC board.
5. Using the 7/16" wrench, loosen the nuts on the positive terminals of the power capacitors. Then remove the nuts, lock washers, and flat washers from the terminals where the positive straps connect to the Power Module PC board. Flip the straps out of the way.
6. Using the 7/16" wrench, loosen the center nut on the negative strap. Using the 7/16" wrench, remove the two bolts, lock washers and flat washers from the diode module. Remove the strap.

POWER MODULE ASSEMBLY
REMOVAL AND REPLACEMENT *(continued)*

7. Label and remove leads #232 and #233 from the temperature switch.
8. Unscrew plug J50 from the vertical baffle. Using the phillips head screw driver, remove the four screws holding the plug to the vertical baffle. Cut any necessary cable ties. Then pull the plug and leads away from the baffle.
9. Using the 3/8" socket wrench, remove the three screws holding the Power Module heat sink to its brackets on the vertical baffle. Remove the glastic fan guard, if present on your machine.
10. Remove the Power Module assembly from the machine.

Replacement

Refer to ***Figures F.21*** and ***F.22.***

1. Mount the heat sink to the brackets on the vertical baffle with the three 3/8" screws. Mount the glastic fan guard, if present.
2. Mount plug J50 to the vertical baffle with four phillips head screws. Connect the plug and screw it together.
3. Install leads #232 and #233 to the temperature switch.
4. Using the 7/16" wrench, attach the negative strap from the power capacitors to the diode module with two bolts, lock washers, and flat washers. Using the 7/16" wrench, tighten the negative strap center nut. Tighten all fasteners to 30-40 in-lbs.
5. Using the 7/16" wrench, attach the positive straps from the power capacitors to the Power Module PC board. Tighten the fasteners at the positive terminals of the power capacitors to between 50 and 60 in-lbs.
6. Mount heavy leads W8 and W9 to the Power Module PC board with the 7/16" nuts, lock washers, and flat washers. Apply a thin coating of electrical thermal joint compound (Penetrox A-13) to the mating surfaces (but not the threads). Tighten the fasteners to between 12 and 18 in-lbs).
7. Replace any cable ties cut at disassembly.

See the procedures below for removal and replacement of the power module PC board and diode module. When procedures are complete, perform the ***Case Cover Replacement*** procedure.

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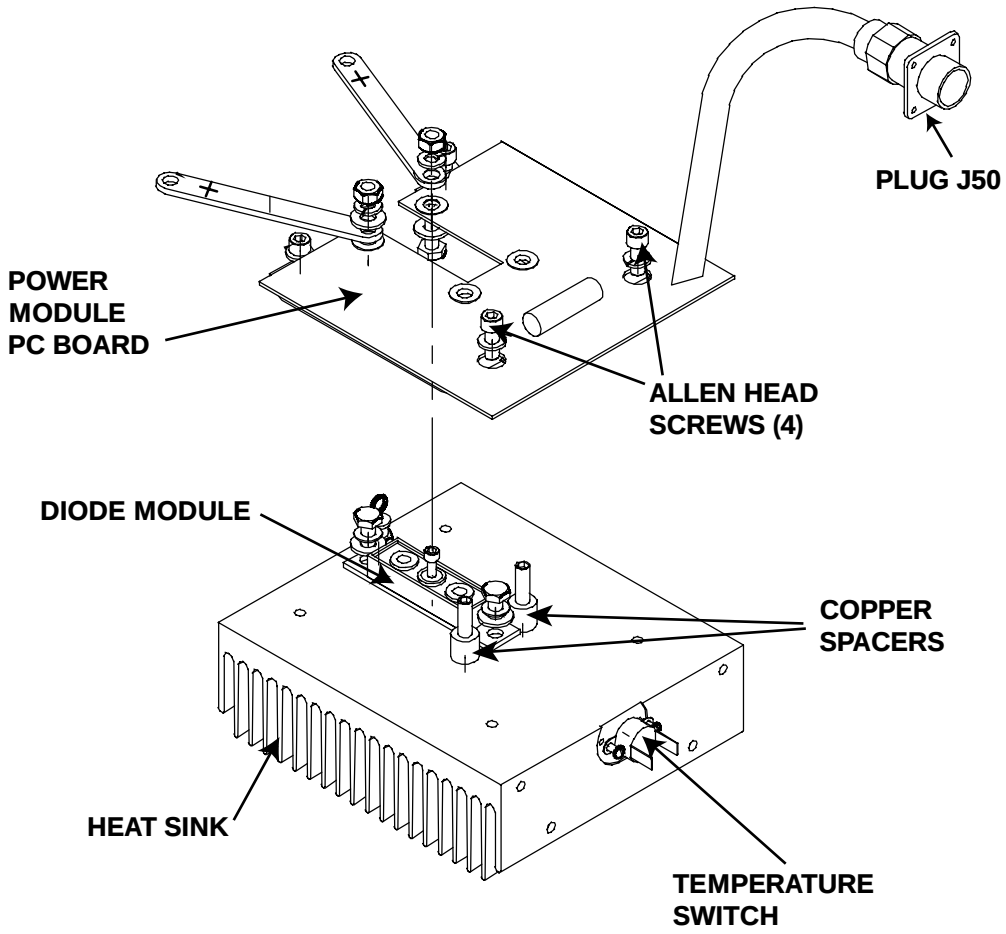
Return to Section TOC
Return to Master TOC

POWER MODULE PC BOARD REMOVAL AND REPLACEMENT

FIGURE F.22 – DIODE MODULE/POWER MODULE ASSEMBLY DETAILS



Removal

1. Perform steps #1 through #6 and #8 from the ***Power Module Assembly Removal*** procedure.
2. Using the 3/16" allen wrench, remove the four screws and lock washers holding the board to the heat sink. Note the two copper spacers for the center terminals for reassembly. See Figure F.22.
3. Remove the PC board.

Replacement

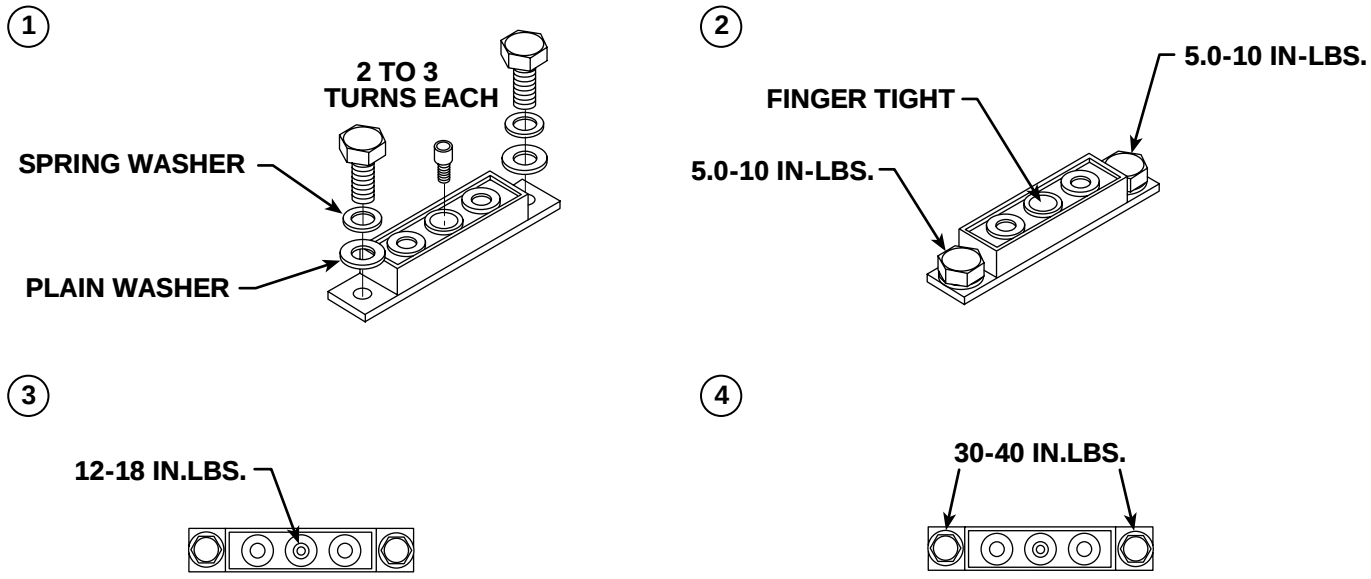
1. Make sure the mating surfaces between the copper spacers and the heat sink are clean, dry, and free of grease.
2. Apply a thin coating of electrical thermal joint compound (Penetrox A-13) to the mating surfaces between the copper spacers and the heat sink.
3. Using the torque wrench and 3/16" allen head socket, install the four set screws and lock washers. Note the two copper spacers required for the center terminals. Tighten the screws finger tight, then to between 24 and 28 in-lbs, then again to between 40 and 48 in-lbs.

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

DIODE MODULE REMOVAL AND REPLACEMENT

FIGURE F.23 – DIODE MODULE MOUNTING DETAILS



Removal

Refer to Figure F.23.

1. Remove the Power Module PC Board as described above.
2. Using the 7/16" wrench, remove the two outer screws, spring washers, and large flat washers from the diode module.
3. Using the 9/64" allen wrench, remove the set screw from the center of the diode module.
4. Remove the diode module from the heat sink.

Replacement

Refer to Figure F.23.

⚠ CAUTION

The proper tightening sequence is required to mount the diode module to the heat sink in order to avoid warping the base plate. Apply the proper torque to all fasteners.

1. Be sure the heat sink mounting surface is clean, dry, and free of grease.
2. Apply a thin, even coat (.1 to .25mm or .004 to .010 in) of thermal joint compound (Penetrax A-13) to the diode module base plate only, under the plastic body of the module. Do not apply compound to the area under the mounting holes.
3. Press the module firmly against the heat sink, aligning the mounting holes.
4. Place a spring washer then a flat washer over each outer mounting screw and insert them into the holes. Insert the allen head screw into the center hole. Tighten all three screws finger-tight only. ①
5. Using the torque wrench and 7/16" socket, tighten each outer screw between 5.0 and 10 in-lbs. ②
6. Using the torque wrench and 9/64" allen head socket, tighten the center screw between 12 and 18 in-lbs. ③
7. Now tighten the two outer screws between 30 and 40 in-lbs. ④
8. Replace the Power Module PC board as described above.

POWER CAPACITOR REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

This procedure will aid the technician in the removal and replacement of the power capacitors.

MATERIALS NEEDED

3/8" Wrench or socket wrench
7/16" Wrench
9/16" Wrench
Slot headed screw driver

This procedure should take approximately 30 minutes to perform.

Return to Section TOC
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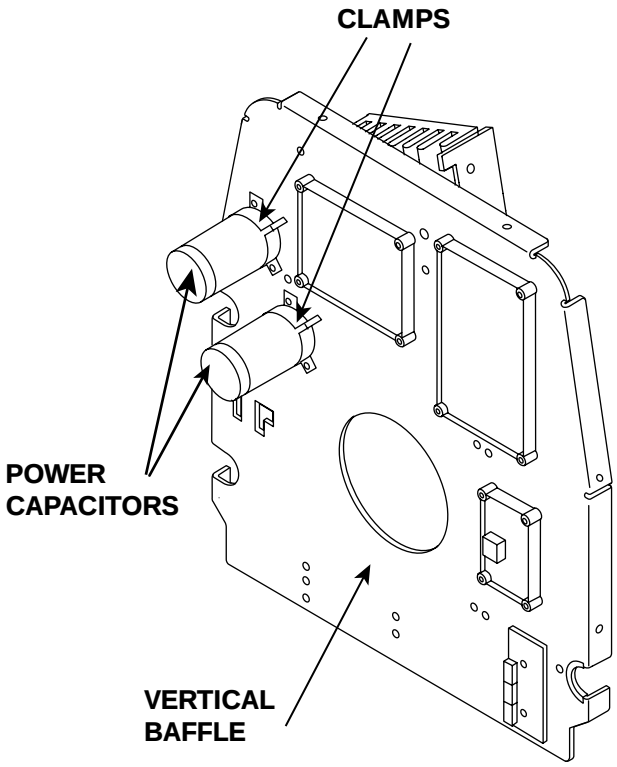
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

POWER CAPACITOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.24 – POWER CAPACITOR MOUNTING DETAILS



PROCEDURE

1. Perform the ***Case Cover Removal*** procedure.
2. Perform the ***Power Module Capacitor Discharge*** procedure.
3. Label all leads for reassembly.
4. With the 7/16" wrench, remove the nuts, lock washers, and flat washers holding the leads and straps to the power capacitor terminals.
5. With the slot headed screw driver, loosen the clamps holding the capacitors to the vertical baffle.
6. Slip the capacitors out of the vertical baffle.

To reassemble, slide the capacitors into the vertical baffle, observe capacitor polarity and lead orientation, and tighten the holding clamps. Replace the leads and straps as labeled and tighten the fasteners to between 50 and 60 in-lbs. Perform the ***Case Cover Replacement*** procedure.

Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing and replacing the output rectifier bridge and the choke from the Ranger 250.

MATERIALS NEEDED

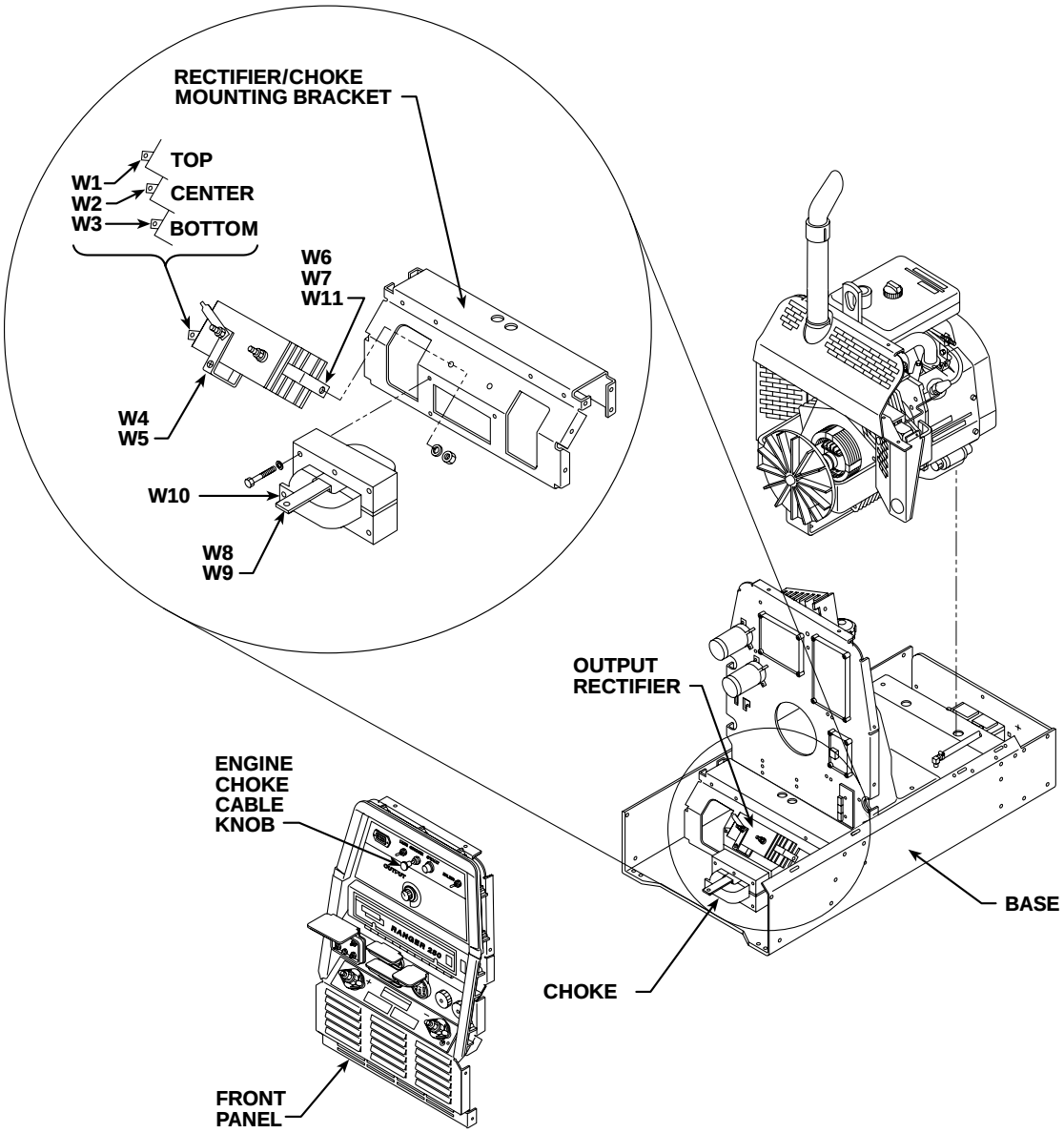
5/16" Nut driver
3/8" Wrench or socket wrench
1/2" Wrenches (two)
9/16" Wrench
Diagonal cutters

This procedure should take approximately 1 hour to perform.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.25 – OUTPUT RECTIFIER BRIDGE DETAILS



REMOVAL PROCEDURE

Refer to Figure F.25.

Output Rectifier

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.
3. ***Perform the Power Module Capacitor Discharge*** procedure.
4. Note the position of the engine choke cable for reassembly purposes. Using the 5/16" nut driver, remove the clamp holding the engine choke cable to the choke control lever at the carburetor. Flex the cable outward to free it from the lever.

Return to Section TOC
Return to Master TOC

Return to Section TOC
Return to Master TOC

OUTPUT RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT *(continued)*

5. Using the 1/2" and 9/16" wrenches, hold and loosen the nut holding the engine choke cable to the back of the front panel. Pull the cable through the front panel. Save the sleeve and nut for reassembly.
6. With the 3/8" socket wrench, remove the four screws holding the front panel to the machine base. Tilt the front panel as far forward as the attached leads will permit. Cut any necessary cable ties.
7. With two 1/2" wrenches, remove heavy leads W6, W11 and W7 and their bolt, lock washers and flat washers from the negative strap on the right side of the output rectifier.
8. With two 1/2" wrenches, remove heavy leads W4 and W5 and their bolt, lock washers and flat washers from the positive strap of the output rectifier.
9. With two 1/2" wrenches remove heavy leads W1, W2, and W3 and their bolts, lock washers and flat washers from the three straps on the left side of the output rectifier.
10. With the 1/2" wrench or socket wrench, remove the nuts and lock washers holding the output rectifier to the machine mounting bracket. You will need to reach through the large access holes on either side of the rectifier to place the wrench on these nuts.
11. Remove the output rectifier from the machine.

Output Choke

1. Remove the output rectifier as described above.
2. Using the 1/2" wrenches, remove the heavy flex leads W8, W9 and W10 from the choke.
3. Using the 1/2" wrenches, remove the three long bolts, lock washers, and nuts holding the choke to the mounting bracket in the machine base. Note that the lower right corner of the choke has no bolt.
4. Carefully remove the choke.

REPLACEMENT PROCEDURE

Output Choke

1. Place the choke into the machine so that the three mounting holes line up with the mounting holes in the machine mounting bracket.
2. Insert the three long bolts through the choke and the mounting bracket. Place a lock washer and nut on each bolt and tighten with the 1/2" wrenches.
3. Using the 1/2" wrenches, attach the heavy flex leads W8, W9 and W10 to the appropriate choke lead connections. See the Wiring Diagram.

Output Rectifier

1. Place the output rectifier into the machine so that its mounting studs fit into the holes in the bracket. Attach the nuts and lock washers using the 1/2" wrench.
2. Attach heavy leads W1, W2, and W3 to the three straps on the left side of the rectifier plates. See ***Figure F.25*** for placement.
3. Attach heavy leads W4 and W5 to the positive strap on the rectifier. See ***Figure F.25*** for placement.
4. Attach heavy leads W6, W11 and W7 to the negative strap of the rectifier. See ***Figure F.25*** for placement.
5. Attach the front panel to the machine base with four 3/8" screws. Replace any cable ties cut during removal.
6. Insert the engine choke cable through the case front, attach it with the 9/16" nut and install the sleeve. Fit the end of the cable into the hole in the choke control lever, then attach the cable to the choke control lever in the position noted at disassembly using its 5/16" clamp.
7. Perform the ***Case Cover Replacement*** procedure.

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ENGINE/STATOR/ROTOR REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual.

If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 216-383-2531 or 1-800-833-9353 (WELD).

DESCRIPTION

The following procedure will aid the technician in removing and replacing the gasoline engine, stator and rotor for repair or replacement. This procedure is for Onan models only. Some procedures may vary slightly for Kohler models.

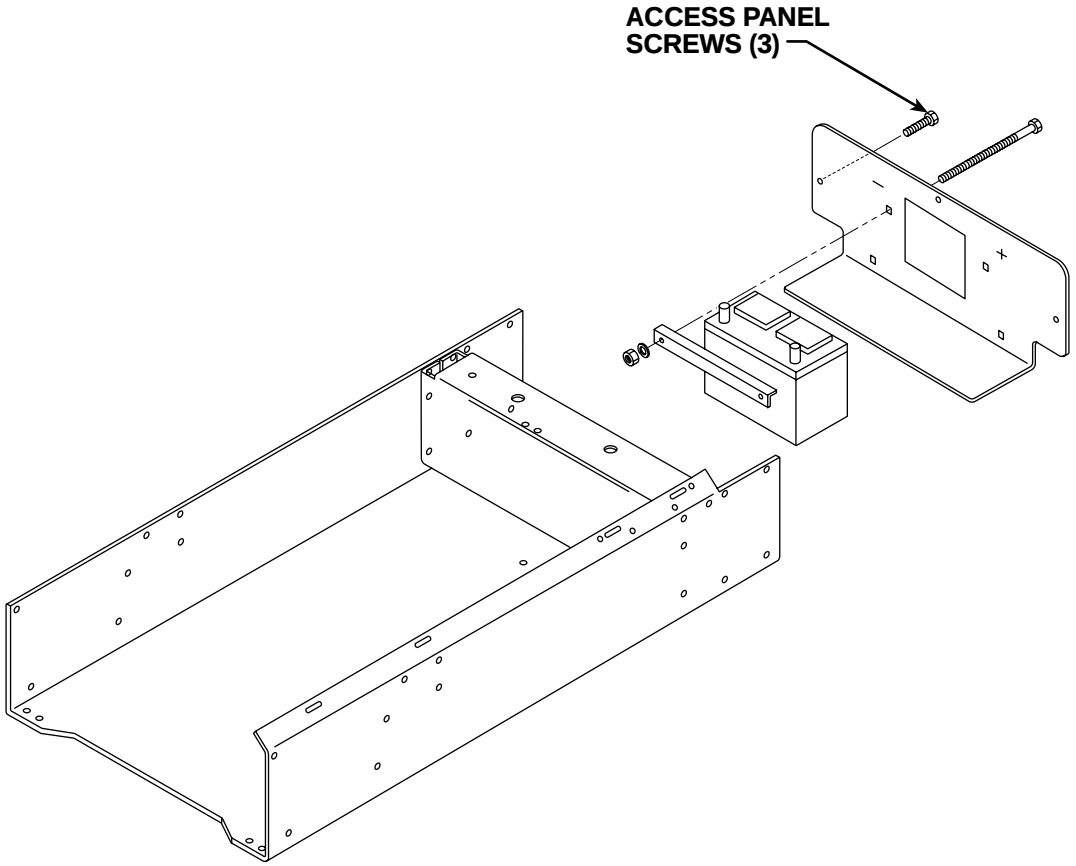
MATERIALS NEEDED

5/16" Nut driver
3/8" Wrench or socket wrench
7/16" Wrench or socket wrench
1/2" Wrench or socket wrench
3/4" Wrench
9/16" Wrench
1/2" Box end wrench
Diagonal cutters
Impact wrench
Loctite 271 thread sealant
3/8" Deep socket
Slot head screw driver
Phillips head screw driver
Gear puller (small)
Hoist, chains, straps
Feeler gauge (for air gap check)
Machine Wiring Diagram
Rubber or wooden mallet
Torque wrench with 1/2" socket

This procedure should take approximately 3 hours to perform.

ENGINE/STATOR/ROTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.26 – BATTERY AND CASE BACK REMOVAL



REMOVAL PROCEDURE

Engine Preparation and Lead Disconnection

1. Turn the engine off.
2. Perform the ***Case Cover Removal*** procedure.
3. Disconnect the spark plug wires from the spark plugs.
4. Perform the ***Power Module Capacitor Discharge*** procedure.
5. Using the 3/8" socket wrench, remove the screws holding the battery access panel to the case back. Slide the panel, with the battery attached, out of the machine far enough to access the battery cables. See Figure F.26.
6. With the 1/2" wrench, loosen the bolt on the negative battery cable clamp. Remove the clamp and cable from the post.
7. Using the 3/8" socket wrench, remove the eight screws holding the case back to the machine base (four on each side). Remove the case back.
8. Using the 1/2" wrench, remove the engine ground strap where it connects to the engine mounting foot on the left side.
9. Note the position of the choke cable for reassembly purposes. Using the 5/16" nut driver, remove the clamp holding the engine choke cable to the choke control lever. Flex the cable outward to free it from the lever.

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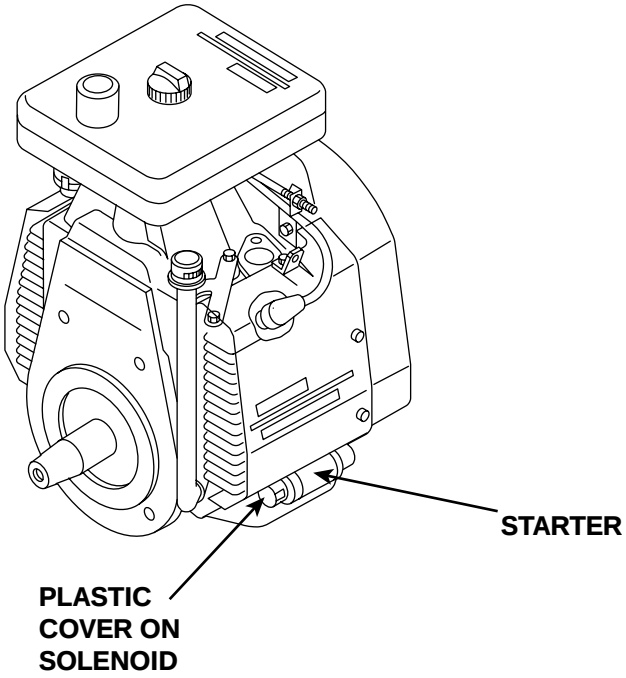
ENGINE/STATOR/ROTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F. 27 – ENGINE STARTER SOLENOID LEADS (ONAN ENGINE SHOWN)



10. Refer to Figure F.27. Label engine starter solenoid leads #211A and #209 (#211A attaches to the solenoid spade terminal and #209 attaches to the positive stud on the solenoid along with the positive battery cable). Pull lead #211A off its spade terminal. To remove lead #209, you will have to remove the plastic cover on the starter first. To do this, use the 1/2" socket wrench to remove the nut on the negative stud of the solenoid. Then remove the plastic cover. Next, remove the 1/2" nut from the positive solenoid stud. Now you can remove lead #209 and the positive battery cable from the starter solenoid.

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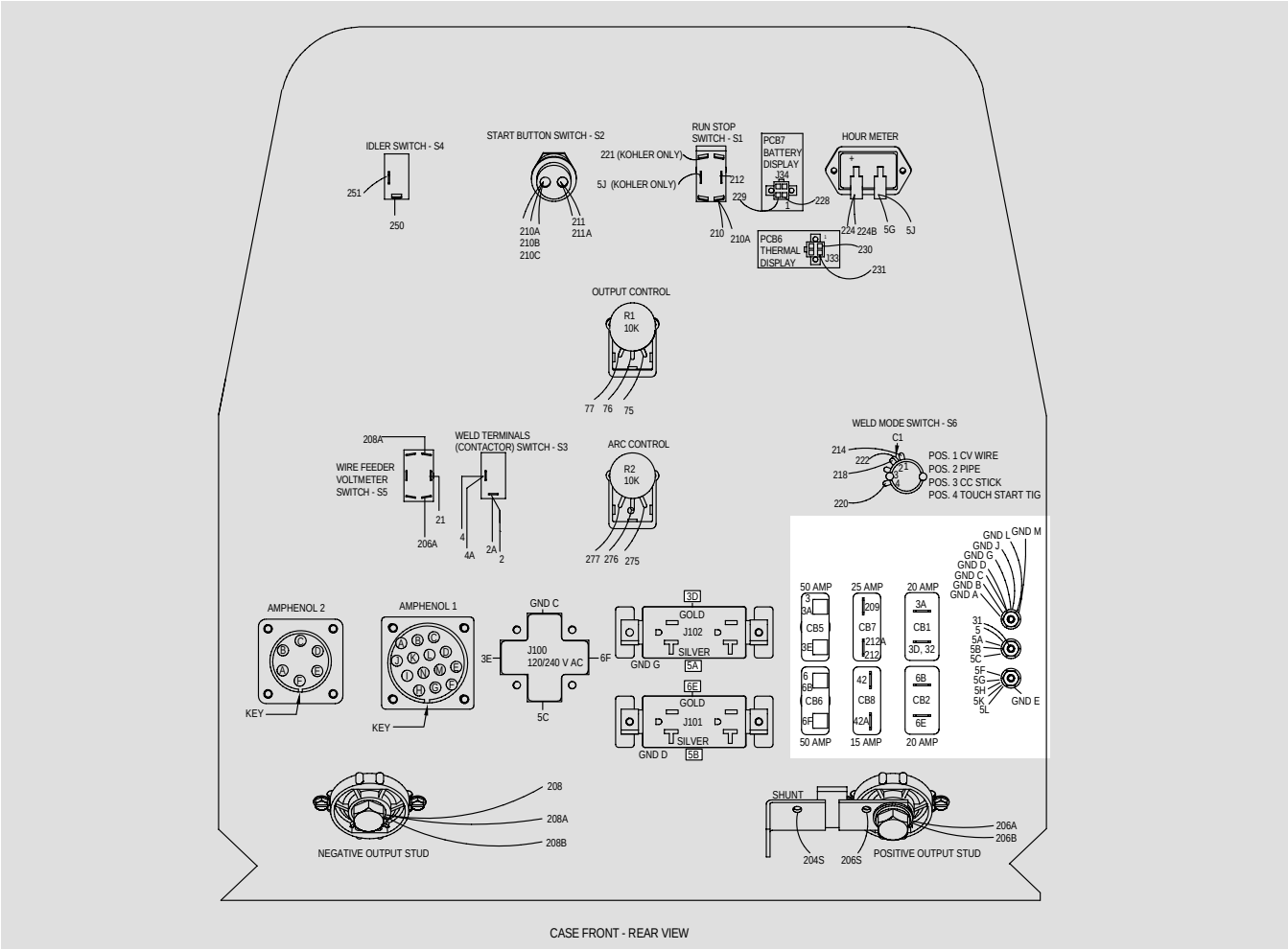
ENGINE/STATOR/ROTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.28 – STATOR LEADS (FRONT PANEL)



Stator Lead Disconnection

Refer to Figure F.28.

NOTE: Use diagonal cutters to cut any cable ties necessary to free the leads as described below.

1. With two 1/2" wrenches remove heavy flex leads W1, W2, and W3 and their bolts, lock washers and flat washers from the straps on the left side of the output rectifier plates. ***See Figure F.25.***
2. Remove field winding leads #7 and #9 from the field rectifier bridge. ***See Figure F.9.***
3. Disconnect lead #41 from its in-line coupling.
4. Using a 3/8" deep socket or wrench, remove leads #5 and GND E from the bottom ground stud on the case front. See the Wiring Diagram.
5. Remove lead #42 from circuit breaker CB8.
6. Remove stator auxiliary winding lead #6 from circuit breaker CB6 and lead #3 from circuit breaker CB5. These leads pass through the toroid. For reassembly, note the number of turns and direction through the toroid for each lead. See the Wiring Diagram.
7. Separate and remove lead #5H, #201, #200A and #200 at their piggy-back connections at the brush holder. See the Wiring Diagram.
8. Disconnect plug J51 (Engine Connector Block).
9. Using the 1/2" wrench, disconnect the engine ground lead (GND J) at the engine foot. This is the small lead that runs to the top ground stud on the case front.

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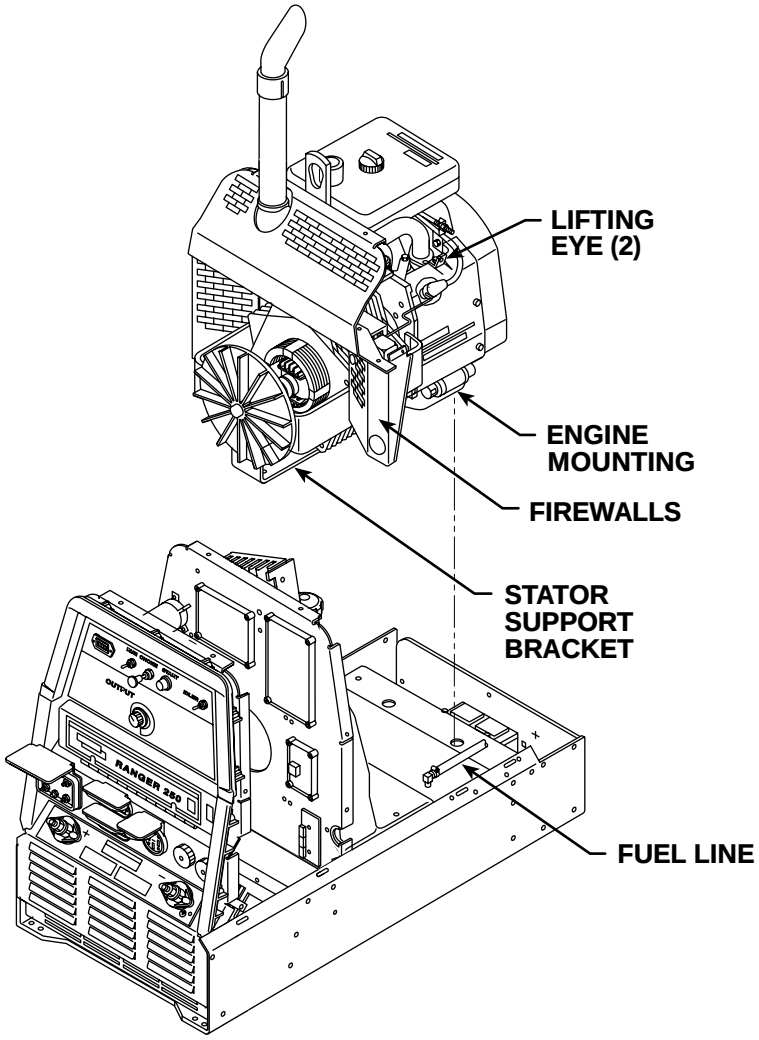
ENGINE/STATOR/ROTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.29 – ENGINE/STATOR/ROTOR ASSEMBLY REMOVAL



Engine/Stator/Rotor Assembly Removal Procedure

Refer to Figure F.29.

1. Attach chains to the lifting eyes on the top sides of the engine and the stator lift bail. Secure the chains to the hoist and put enough tension on them to support the engine but without lifting the assembly.
2. Using the 9/16" wrench, remove the two bolts, lock washers, and nuts from the stator bottom support bracket and two bolts, washers and nuts from the engine mountings.
3. Remove the fuel line at the carburetor and plug it.
4. Using the hoist, you can now lift the engine/stator assembly free from the machine base. Note that the firewall baffle assembly surrounding the muffler (Onan engine machines) and stator come with the engine/stator/rotor assembly. It is not secured to the machine base.
5. Set the assembly carefully on a workbench or the floor. Place a wooden block under the stator before removing support from the hoist.

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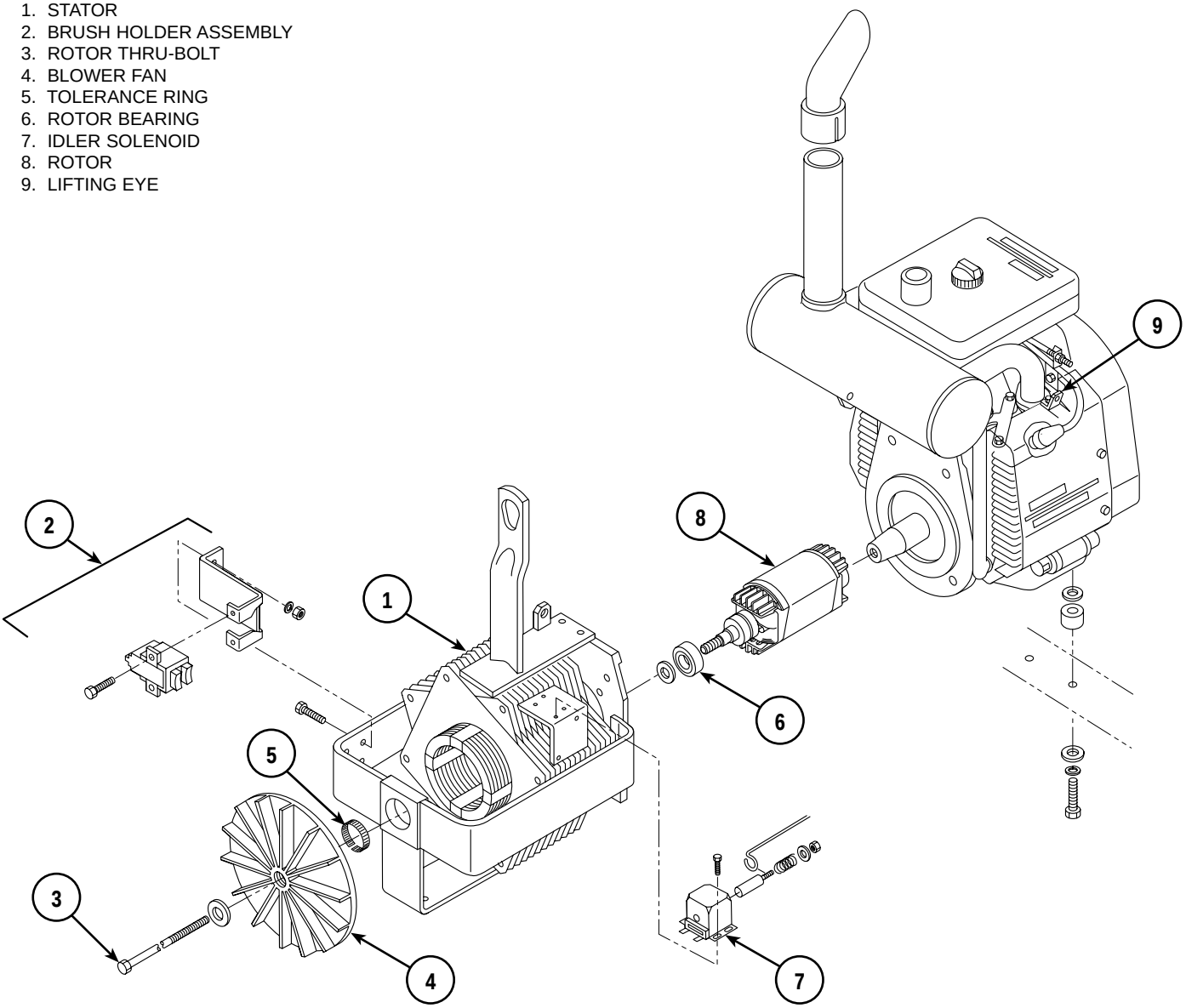
ENGINE/STATOR/ROTOR REMOVAL AND REPLACEMENT *(continued)*

FIGURE F.30 – STATOR AND ROTOR REMOVAL

1. STATOR
2. BRUSH HOLDER ASSEMBLY
3. ROTOR THRU-BOLT
4. BLOWER FAN
5. TOLERANCE RING
6. ROTOR BEARING
7. IDLER SOLENOID
8. ROTOR
9. LIFTING EYE



Stator/Rotor Assembly Removal

Refer to Figure F.30.

1. Support the stator with the hoist.
2. Using the 1/2" wrench, remove the bolt, washers, and nut holding the muffler to the stator (Onan engine machines). Remove the bolts and washers holding the muffler to the engine and remove the muffler.
3. Disconnect the idler solenoid linkage at its clip.
4. Using the 7/16" wrench, remove the two nuts, lock washers, and bolts holding the brush holder assembly to the stator frame. Remove the brush holder assembly.
5. Unscrew the fan to remove it from the shaft. Turn the fan counterclockwise. Be careful not to lose the washer that fits between the blower fan and the rotor.

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ENGINE/STATOR/ROTOR REMOVAL AND REPLACEMENT *(continued)*

6. **Double check that the spark plug wires are disconnected.** You will be turning the rotor during this procedure, and this could cause engine kickback.
7. Hold the rotor shaft with locking pliers. With the 5/8" wrench or an impact wrench, remove the rotor thru-bolt. Hold the rotor with one hand and shock the wrench with a mallet to loosen the thru-bolt. The thru-bolt has a centering washer, tapered to conform to the rotor shaft.
8. Remove the thru-bolt and washer from the end of the rotor.
9. Install the appropriate long thru-bolt (two are provided) supplied with Lincoln Electric Rotor Puller Kit S20788. The slot head must face out. Screw in the bolt with the slot head screw driver until the bolt bottoms out on the engine crankshaft, about 3/4".
10. Turning it counterclockwise, screw in the left-hand thread rotor removal tool from the kit into the rotor shaft. Carefully prevent the rotor from turning - use locking pliers. Tighten the tool to approximately 50 ft lbs with the torque or impact wrench. The rotor should "pop" off the engine crankshaft.
11. If the rotor does not pop off, continue to carefully prevent the rotor shaft from turning and tighten the rotor removal tool an additional 5 ft lbs. until the rotor pops off the engine crankshaft.
12. With the 7/16" wrench, remove the side firewalls.
13. With the 9/16" wrench, remove the four bolts that hold the stator to the engine. There is one lock washer per bolt.
14. Carefully remove the stator/rotor assembly from the engine. Once the assembly is separated from the engine, be careful that the rotor does not fall out of the stator.
15. Carefully remove the rotor from the stator. You can tap carefully on the end of the rotor shaft with a rubber mallet. Guide the rotor carefully to prevent damage to its core.

REASSEMBLY NOTES

Reassemble the rotor and stator to the Ranger 250 by carefully retracing the disassembly procedure steps in reverse order. Keep the following special points in mind as you proceed. A Lead Reconnection Checklist is provided here to aid in reassembly.

Rotor/Stator/Engine Reassembly

Refer to ***Figure F.30***.

NOTE: Lincoln Electric recommends that you install a new bearing (Lincoln part #M9300-85) and tolerance ring (Lincoln part #S18044-9) any time the stator and rotor are reassembled.

1. Fit the rotor into the stator, being careful not to damage the rotor core against the stator. Position the rotor so that the laminations are at top and bottom and air gap at the sides. This will limit movement of the rotor. IMPROPER HANDLING OF THE ROTOR CAN RESULT IN SHORTED WINDINGS AND/OR LOST OUTPUT.
2. Tap the rotor carefully with a mallet to fit the bearing all the way into the stator frame.
3. Clean the tapered engine crankshaft.
4. Using the hoist, carefully fit the stator/rotor assembly onto the engine crankshaft.
5. Install the four bolts that mount the stator to the engine. NOTE: Apply Loctite 271 thread sealant to the two bottom bolts on the ONAN engine, to prevent oil leakage from the crankcase. With the 9/16" wrench, draw the bolts up evenly in order to seat the rotor bearing properly. Tighten moving diagonally from bolt to bolt.

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ENGINE/STATOR/ROTOR REMOVAL AND REPLACEMENT *(continued)*

6. Insert the rotor thru-bolt and centering washer. With the torque wrench and socket, tighten the bolt to 50 ft lbs. Then recheck all four engine-stator mounting bolts for tightness.
7. Check the rotor-stator air gap with a .017 feeler gauge. The measurement is taken at the blower end of the rotor before the fan is reinstalled. (The rotor has two flat sides, which are not measured for air gap.) Slide in the gauge. Then rotate the shaft 180 degrees and measure again. If the gauge does not clear, loosen the rotor thru-bolt and four engine-stator bolts; retighten the bolts and recheck the air gap. Repeat until the proper .017 minimum air gap is achieved.
8. Screw the blower fan back onto the end of the rotor shaft. Be sure the washer is in place and hand-tighten the fan only.
9. Install the muffler to the engine. Use new gaskets if necessary. Position the vertical firewall as you install the muffler. Then install the 1/2" bolt, washers, and nut that hold the muffler to the stator frame.
10. Install the side firewalls.
11. Reassemble the idler solenoid linkage.
12. Connect the engine ground strap to the engine mounting foot.
13. Attach the stator to its bottom support bracket and reinstall the engine mounting hardware.
14. Connect the engine starter solenoid leads.
15. Connect the engine choke cable and fuel line.
16. Install the brush holder assembly and leads.
17. Install the case back.
18. Install the battery. Connect the positive battery cable first, then the negative battery cable. BE SURE TO CONNECT THE POSITIVE BATTERY CABLE FIRST.

LEAD RECONNECTION CHECKLIST

Engine

- ❒ Plug J51
- ❒ Brush leads #201(-) and 5H (-) and #200A(+) and #200 (+) at their proper brush holder connections

Stator

- ❒ Heavy leads #W1, W2, and W3 to the output rectifier bridge
- ❒ Field winding leads #7 and #9 to the field rectifier bridge
- ❒ Lead #41 to #41A at their in-line coupling

Front Panel

- ❒ Small green engine ground lead to the top ground stud on the case front panel (GND J)
- ❒ Lead #5 and GND E to bottom ground stud
- ❒ Lead #6 to circuit breaker CB6 and lead #3 to circuit breaker CB5 through the toroid (Note number of turns and direction. See the Wiring Diagram.)
- ❒ Lead #42 to circuit breaker CB8

GENERAL NOTES ON REASSEMBLY

1. Replace any cable ties cut during disassembly.
2. When installing the battery, connect the positive battery cable, then the negative battery cable. BE SURE TO CONNECT THE POSITIVE BATTERY CABLE FIRST.
3. Connect the spark plug wires.
4. Perform the ***Case Cover Replacement*** procedure.
5. Conduct the ***Retest after Repair*** procedure, the following topic in this section of the manual.

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TROUBLESHOOTING & REPAIR

RETEST AFTER REPAIR

Retest a machine:

- If it is rejected under test for any reason that requires you to remove any mechanical part which could affect the machine's electrical characteristics. OR
- If you repair or replace any electrical components.

ENGINE OUTPUT

Mode	No Load RPM	Load RPM
Low Idle	2350 - 2450	N/A
High Idle	3700 - 3750	3350 - 3580

WELDER DC (STICK) OUTPUT (ARC control @ -10)

Mode Selector Switch	Output Control	Open Circuit Volts	Load Volts	Load Amps
Stick (CC)	Maximum	74-79	25-30	245-265

WELDER CV (WIRE) OUTPUT (ARC Control @ +10)

Mode Selector Switch	Output Control	Open Circuit Voltage	Load Volts	Load Amps
CV	Maximum	56-64	25-30	245-265
CV	Minimum	20-28	13-14.5	25-30

TOUCH START TIG (ARC Control @ +10)

Mode Selector Switch	Output Control	Open Circuit Voltage	Load Volts	Load Amps
TIG	Maximum	16-19	25-30	245-265
TIG	Minimum	16-19	Short Circuit	19-24

AUXILIARY POWER OUTPUT

240 Volt Receptacle			120 Volt Receptacles		
Open Circuit Voltage	Load Volts	Load Amps	Open Circuit Voltage	Load Volts	Load Amps
236-252	216-225	35-39	118-126	110-120	18-22

42 VOLT WIRE FEEDER POWER

Open Circuit Voltage	Load Volts	Load Amps
42-46	40-44	7.0-9.0

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ELECTRICAL DIAGRAMS

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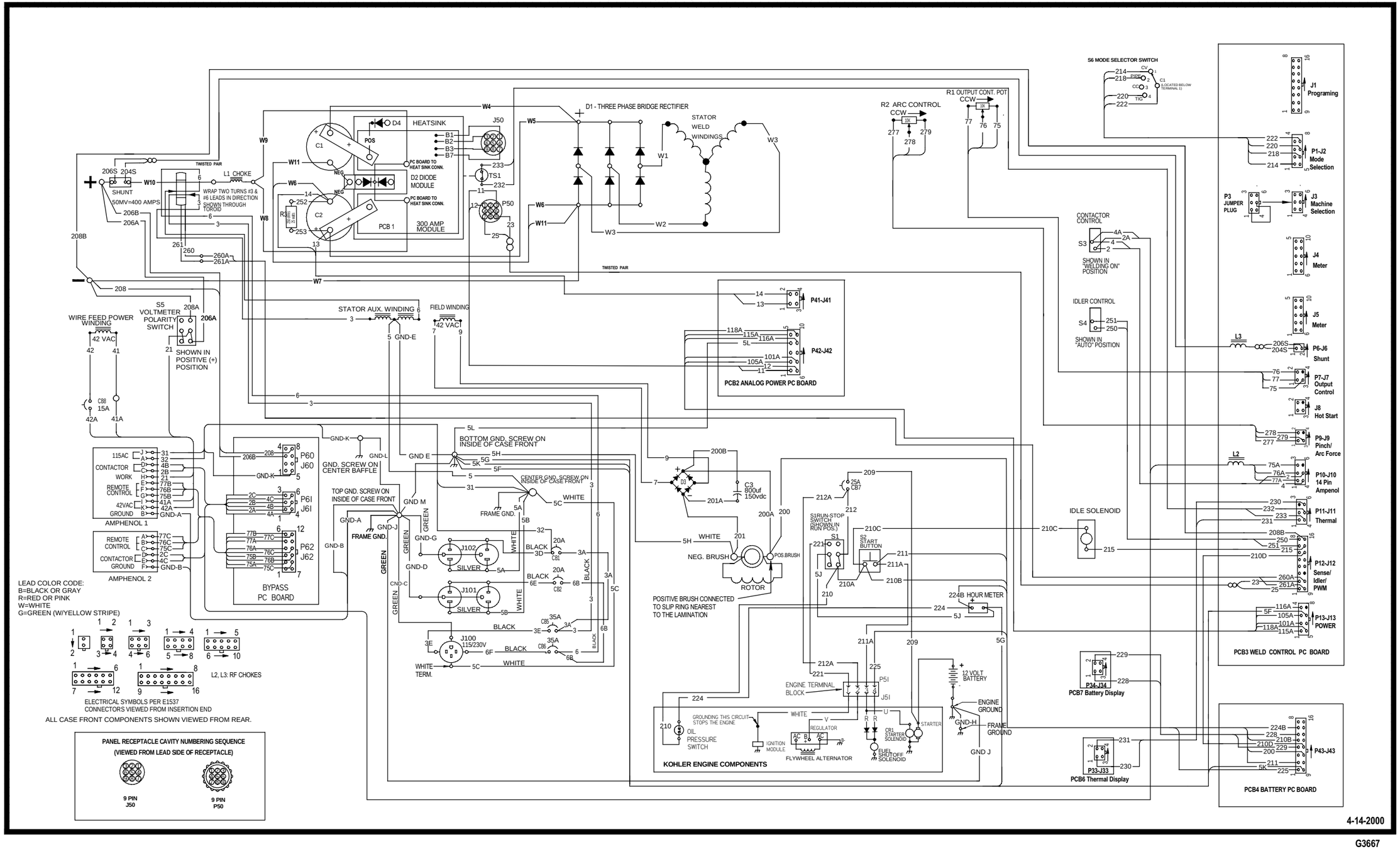
WIRING DIAGRAM - RANGER 250 KOHLER

RANGER 250 KOHLER - WIRING DIAGRAM



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NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

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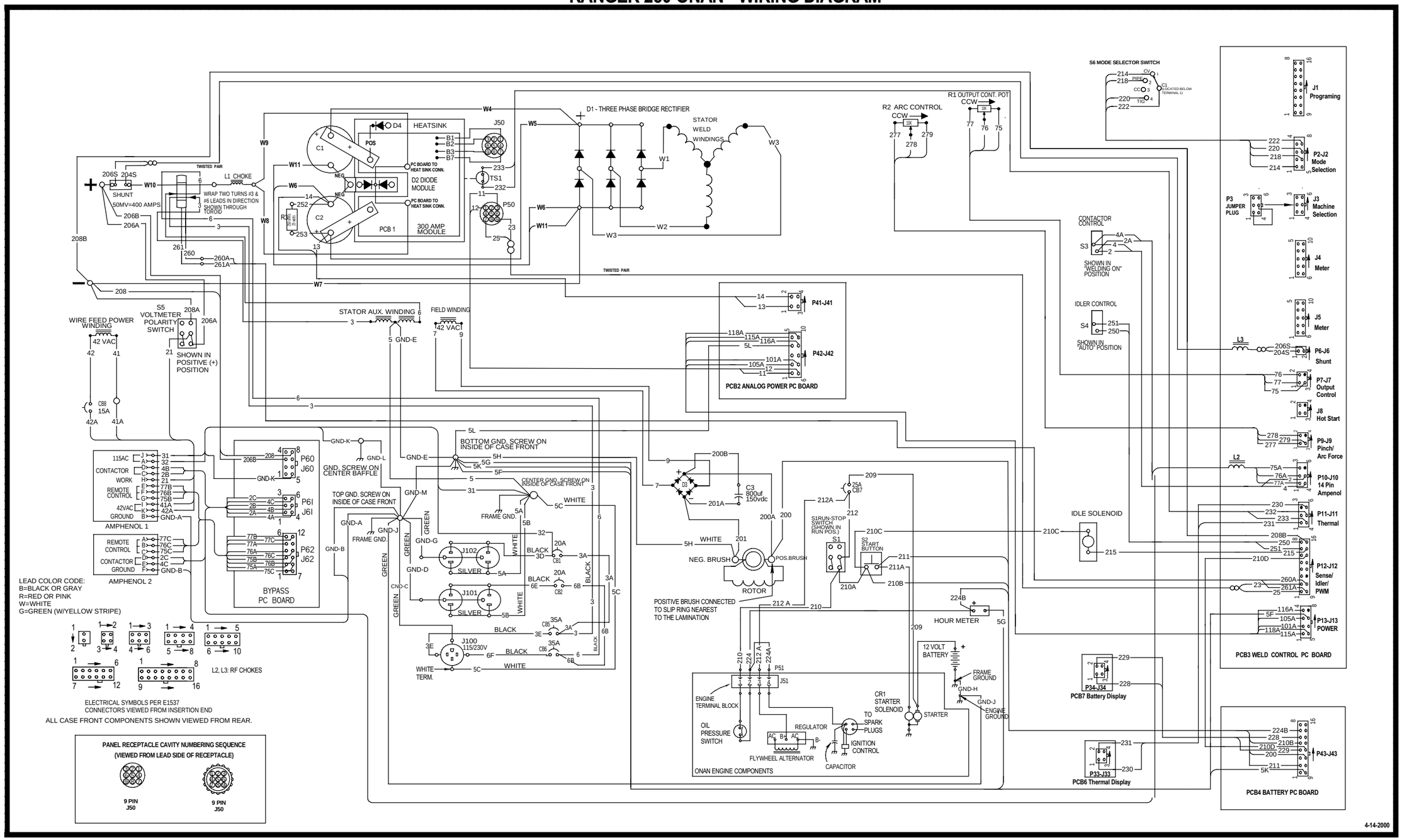
WIRING DIAGRAM - RANGER 250 ONAN

RANGER 250 ONAN - WIRING DIAGRAM



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The wiring diagram specific to your code is pasted inside one of the enclosure panels of your machine.

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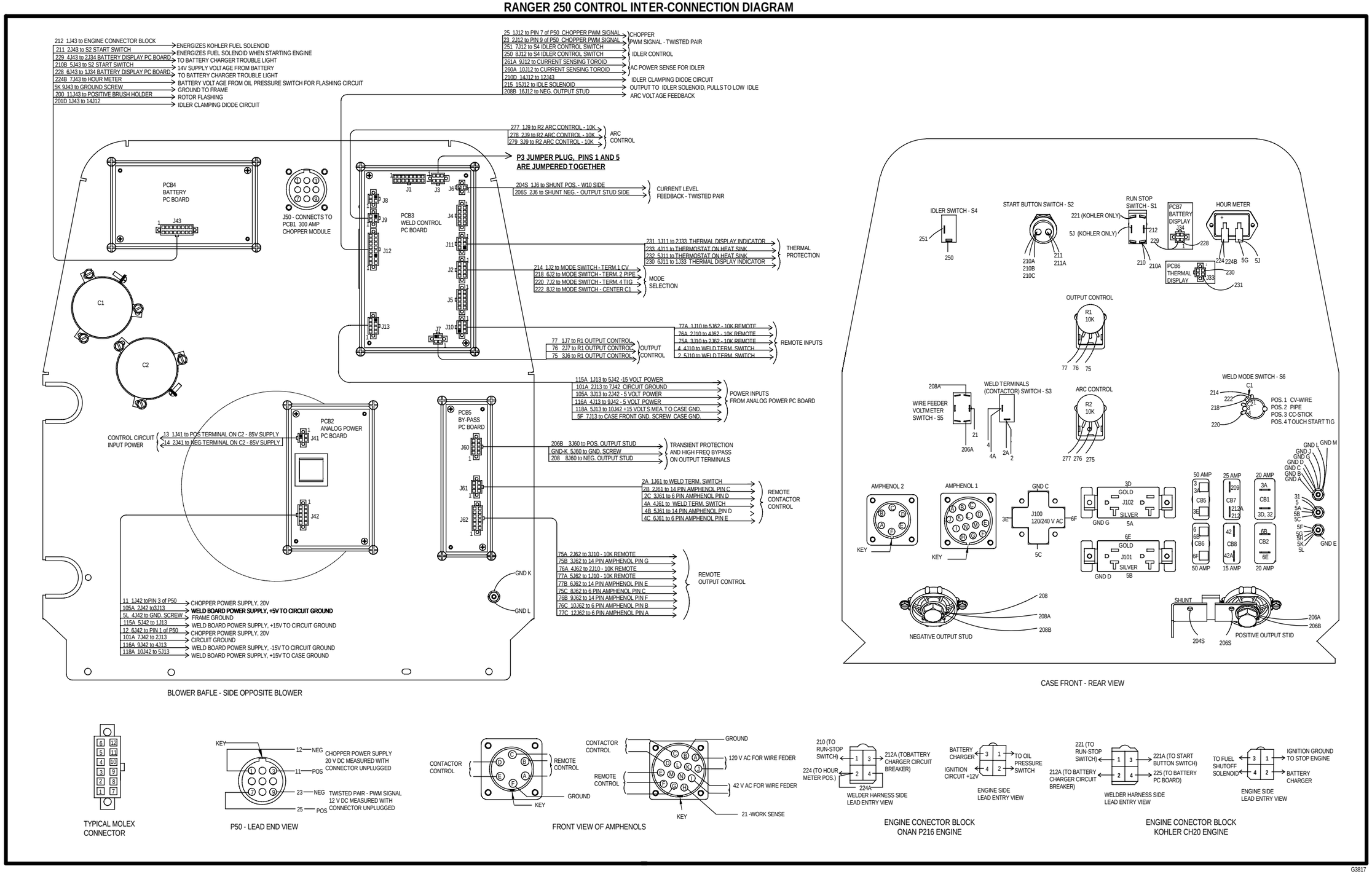
CONTROL INTER-CONNECTION DIAGRAM

RANGER 250 CONTROL INTER-CONNECTION DIAGRAM

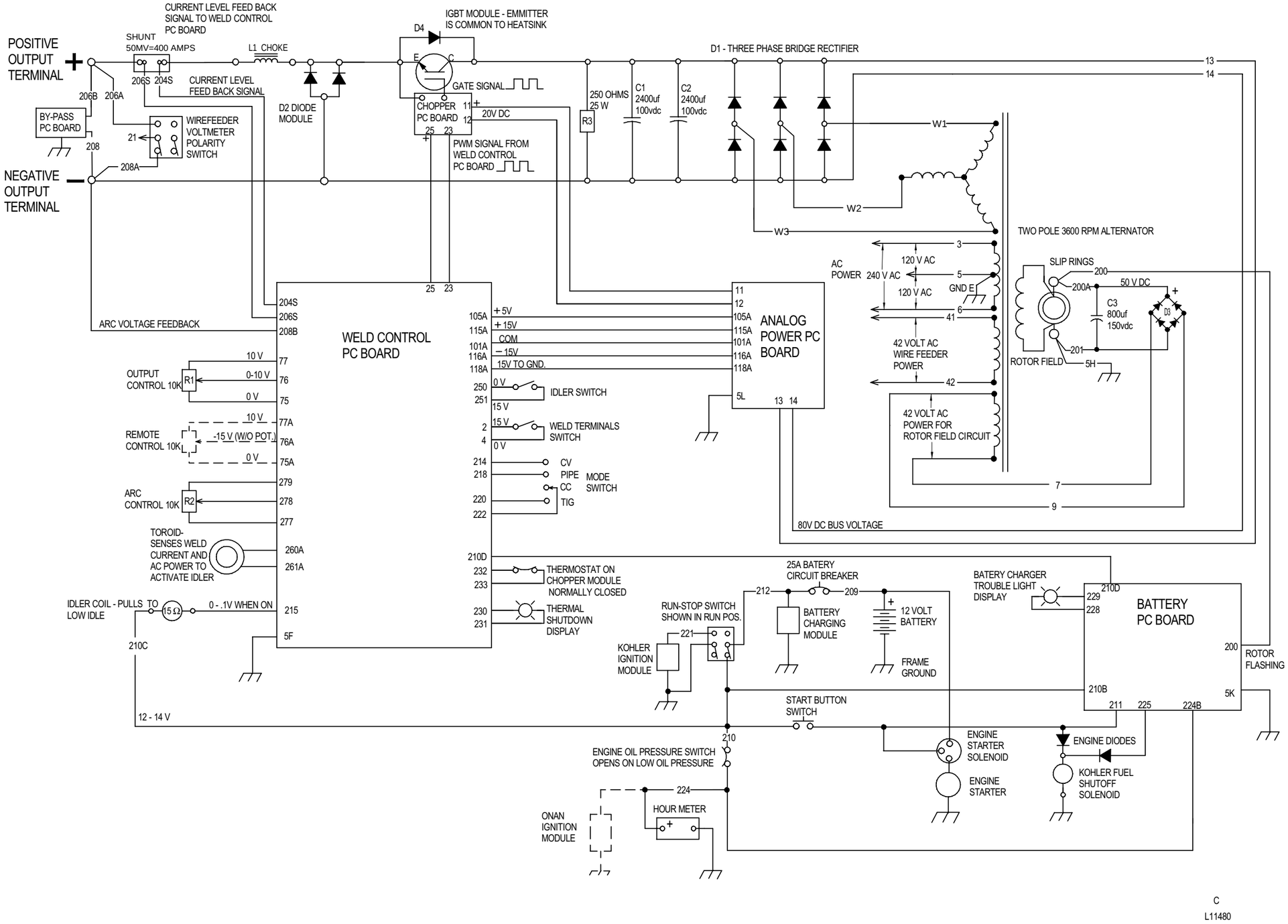

212 1J43 to ENGINE CONNECTOR BLOCK
ENERGIZES KOHLER FUEL SOLENOID
211 2J43 to S2 START SWITCH
ENERGIZES FUEL SOLENOID WHEN STARTING ENGINE
229 4J43 to 2J34 BATTERY DISPLAY PC BOARD
TO BATTERY CHARGER TROUBLE LIGHT
210B 5J43 to S2 START SWITCH
14V SUPPLY VOLTAGE FROM BATTERY
228 6J43 to 1J34 BATTERY DISPLAY PC BOARD
TO BATTERY CHARGER TROUBLE LIGHT
224B 7J43 to HOUR METER
BATTERY VOLTAGE FROM OIL PRESSURE SWITCH FOR FLASHING CIRCUIT
5K 9J43 to GROUND SCREW
GROUND TO FRAME
200 11J43 to POSITIVE BRUSH HOLDER
ROTOR FLASHING
201D 13J43 to 14J12
IDLER CLAMPING DIODE CIRCUIT
25 1J12 to PIN 7 of P50 CHOPPER PWM SIGNAL
23 2J12 to PIN 9 of P50 CHOPPER PWM SIGNAL
CHOPPER PWM SIGNAL - TWISTED PAIR
251 7J12 to S4 IDLER CONTROL SWITCH
250 8J12 to S4 IDLER CONTROL SWITCH
IDLER CONTROL
261A 9J12 to CURRENT SENSING TOROID
260A 10J12 to CURRENT SENSING TOROID
AC POWER SENSE FOR IDLER
210D 14J12 to 12J43
IDLER CLAMPING DIODE CIRCUIT
215 15J12 to IDLE SOLENOID
OUTPUT TO IDLER SOLENOID, PULLS TO LOW IDLE
208B 16J12 to NEG. OUTPUT STUD
ARC VOLTAGE FEEDBACK
277 1J9 to R2 ARC CONTROL - 10K
278 2J9 to R2 ARC CONTROL - 10K
279 3J9 to R2 ARC CONTROL - 10K
ARC CONTROL
P3 JUMPER PLUG, PINS 1 AND 5 ARE JUMPERED TOGETHER
PCB4 BATTERY PC BOARD
J43
J50 - CONNECTS TO PCB1 300 AMP CHOPPER MODULE
PCB3 WELD CONTROL PC BOARD
204S 1J6 to SHUNT POS. - W10 SIDE
206S 2J6 to SHUNT NEG. - OUTPUT STUD SIDE
CURRENT LEVEL FEEDBACK - TWISTED PAIR
231 1J11 to 2J33 THERMAL DISPLAY INDICATOR
233 4J11 to THERMOSTAT ON HEAT SINK
232 5J11 to THERMOSTAT ON HEAT SINK
230 6J11 to 1J33 THERMAL DISPLAY INDICATOR
THERMAL PROTECTION
214 1J2 to MODE SWITCH - TERM 1 CV
218 6J2 to MODE SWITCH - TERM. 2 PIPE
220 7J2 to MODE SWITCH - TERM. 4 TIG
222 8J2 to MODE SWITCH - CENTER C1
MODE SELECTION
77A 1J10 to 5J62 - 10K REMOTE
76A 2J10 to 4J62 - 10K REMOTE
75A 3J10 to 2J62 - 10K REMOTE
4 4J10 to WELD TERM. SWITCH
2 5J10 to WELD TERM. SWITCH
REMOTE INPUTS
77 1J7 to R1 OUTPUT CONTROL
76 2J7 to R1 OUTPUT CONTROL
75 3J6 to R1 OUTPUT CONTROL
OUTPUT CONTROL
115A 1J13 to 5J42 -15 VOLT POWER
101A 2J13 to 7J42 CIRCUIT GROUND
105A 3J13 to 2J42 - 5 VOLT POWER
116A 4J13 to 9J42 - 5 VOLT POWER
118A 5J13 to 10J42 +15 VOLT S.MEA. TO CASE GND.
5F 7J13 to CASE FRONT GND. SCREW CASE GND.
POWER INPUTS FROM ANALOG POWER PC BOARD
CONTROL CIRCUIT INPUT POWER
13 1J41 to POS TERMINAL ON C2 - 85V SUPPLY
14 2J41 to NEG TERMINAL ON C2 - 85V SUPPLY
PCB2 ANALOG POWER PC BOARD
PCB5 BY-PASS PC BOARD
206B 3J60 to POS. OUTPUT STUD
GND-K 5J60 to GND. SCREW
208 8J60 to NEG. OUTPUT STUD
TRANSIENT PROTECTION AND HIGH FREQ BYPASS ON OUTPUT TERMINALS
2A 1J61 to WELD TERM. SWITCH
2B 2J61 to 14 PIN AMPHENOL PIN C
2C 3J61 to 6 PIN AMPHENOL PIN D
4A 4J61 to WELD TERM. SWITCH
4B 5J61 to 14 PIN AMPHENOL PIN D
4C 6J61 to 6 PIN AMPHENOL PIN E
REMOTE CONTACTOR CONTROL
75A 2J62 to 3J10 - 10K REMOTE
75B 3J62 to 14 PIN AMPHENOL PIN G
76A 4J62 to 2J10 - 10K REMOTE
77A 5J62 to 1J10 - 10K REMOTE
77B 6J62 to 14 PIN AMPHENOL PIN E
75C 8J62 to 6 PIN AMPHENOL PIN C
76B 9J62 to 14 PIN AMPHENOL PIN F
76C 10J62 to 6 PIN AMPHENOL PIN B
77C 12J62 to 6 PIN AMPHENOL PIN A
REMOTE OUTPUT CONTROL
GND K
GND L
11 1J42 toPIN 3 of P50
CHOPPER POWER SUPPLY, 20V
105A 2J42 to3J13
WELD BOARD POWER SUPPLY, +5V TO CIRCUIT GROUND
5L 4J42 to GND. SCREW
FRAME GROUND
115A 5J42 to 1J13
WELD BOARD POWER SUPPLY, +15V TO CIRCUIT GROUND
12 6J42 to PIN 1 of P50
CHOPPER POWER SUPPLY, 20V
101A 7J42 to 2J13
CIRCUIT GROUND
116A 9J42 to 4J13
WELD BOARD POWER SUPPLY, -15V TO CIRCUIT GROUND
118A 10J42 to 5J13
WELD BOARD POWER SUPPLY, +15V TO CASE GROUND
BLOWER BAFLE - SIDE OPPOSITE BLOWER
IDLER SWITCH - S4
START BUTTON SWITCH - S2
RUN STOP SWITCH - S1
221 (KOHLER ONLY)
5J (KOHLER ONLY)
PCB7 BATTERY DISPLAY
HOUR METER
PCB6 THERMAL DISPLAY
OUTPUT CONTROL
R1 10K
WELD TERMINALS (CONTACTOR) SWITCH - S3
WIRE FEEDER VOLTMETER SWITCH - S5
ARC CONTROL
R2 10K
WELD MODE SWITCH - S6
POS. 1 CV-WIRE
POS. 2 PIPE
POS. 3 CC-STICK
POS. 4 TOUCH START TIG
AMPHENOL 2
AMPHENOL 1
KEY
J100 120/240 V AC
3D GOLD J102 SILVER GND G 5A
6E GOLD J101 SILVER GND D 5B
50 AMP CB5
25 AMP CB7
20 AMP CB1
50 AMP CB6
15 AMP CB8
20 AMP CB2
3D, 32
6E
GND A
GND B
GND C
GND D
GND E
GND G
GND J
GND L
GND M
NEGATIVE OUTPUT STUD
SHUNT
POSITIVE OUTPUT STID
CASE FRONT - REAR VIEW
TYPICAL MOLEX CONNECTOR
P50 - LEAD END VIEW
CHOPPER POWER SUPPLY 20 V DC MEASURED WITH CONNECTOR UNPLUGGED
TWISTED PAIR - PWM SIGNAL 12 V DC MEASURED WITH CONNECTOR UNPLUGGED
CONTACTOR CONTROL
REMOTE CONTROL
GROUND
120 V AC FOR WIRE FEDER
42 V AC FOR WIRE FEDER
21 -WORK SENSE
FRONT VIEW OF AMPHENOLS
210 (TO RUN-STOP SWITCH)
224 (TO HOUR METER POS.)
212A (TOBATTERY CHARGER CIRCUIT BREAKER)
WELDER HARNESS SIDE LEAD ENTRY VIEW
ENGINE CONECTOR BLOCK ONAN P216 ENGINE
BATTERY CHARGER
IGNITION CIRCUIT +12V
TO OIL PRESSURE SWITCH
ENGINE SIDE LEAD ENTRY VIEW
221 (TO RUN-STOP SWITCH)
212A (TO BATTERY CHARGER CIRCUIT BREAKER)
221A (TO START BUTTON SWITCH)
225 (TO BATTERY PC BOARD)
ENGINE CONECTOR BLOCK KOHLER CH20 ENGINE
TO FUEL SHUTOFF SOLENOID
IGNITION GROUND TO STOP ENGINE
BATTERY CHARGER

G3817

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

ENHANCED WIRING DIAGRAM

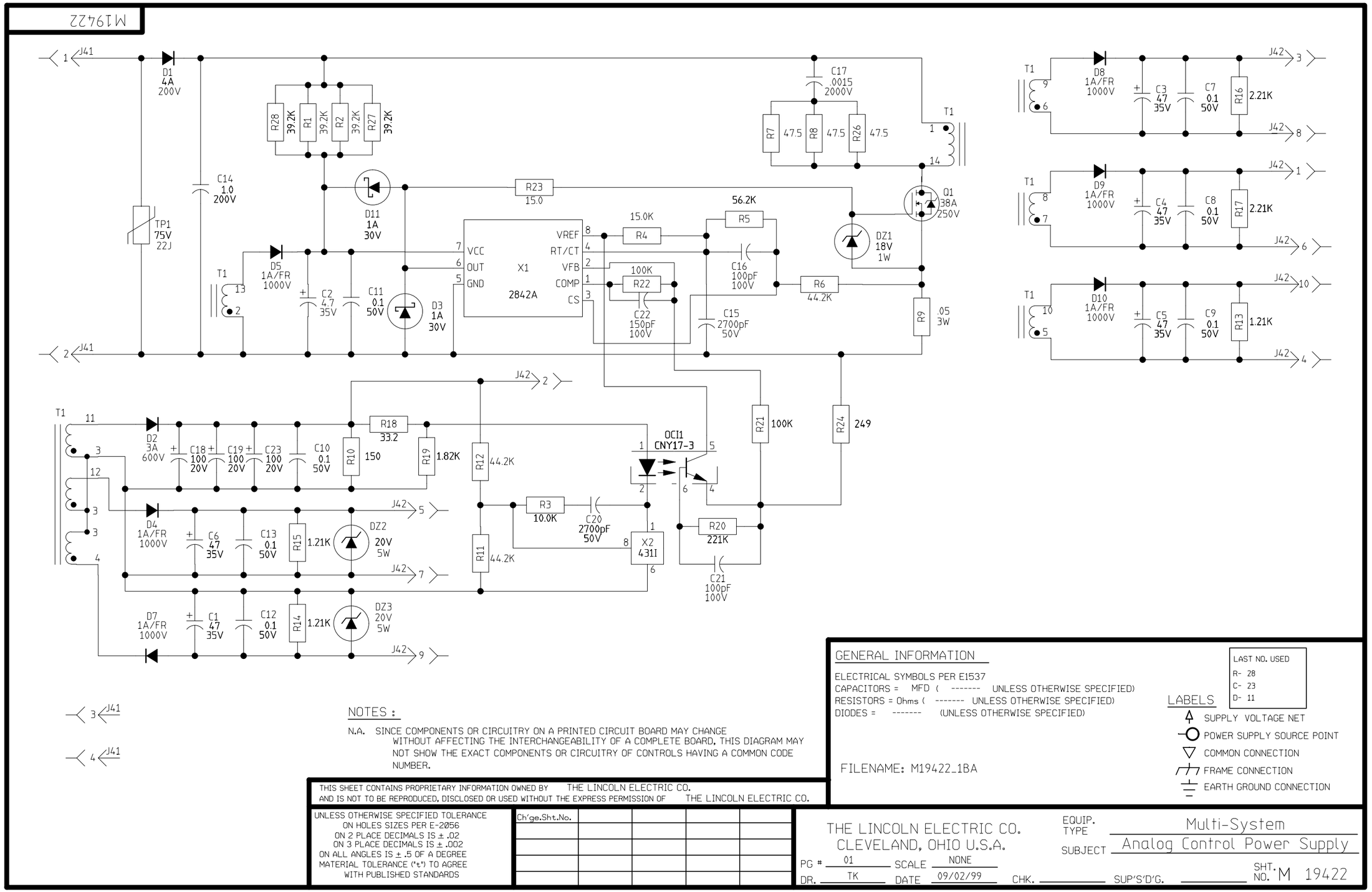
SCHEMATIC - COMPLETE MACHINE



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

SCHEMATIC - ANALOG CONTROL POWER SUPPLY



NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (------- UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (------- UNLESS OTHERWISE SPECIFIED)
DIODES = ------- (UNLESS OTHERWISE SPECIFIED)

LAST NO. USED
R- 28
C- 23
D- 11

LABELS
- SUPPLY VOLTAGE NET
- POWER SUPPLY SOURCE POINT
- COMMON CONNECTION
- FRAME CONNECTION
- EARTH GROUND CONNECTION

FILENAME: M19422_1BA

THIS SHEET CONTAINS PROPRIETARY INFORMATION OWNED BY THE LINCOLN ELECTRIC CO.
AND IS NOT TO BE REPRODUCED, DISCLOSED OR USED WITHOUT THE EXPRESS PERMISSION OF THE LINCOLN ELECTRIC CO.

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLES SIZES PER E-2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS

Ch'ge.Sht.No.				

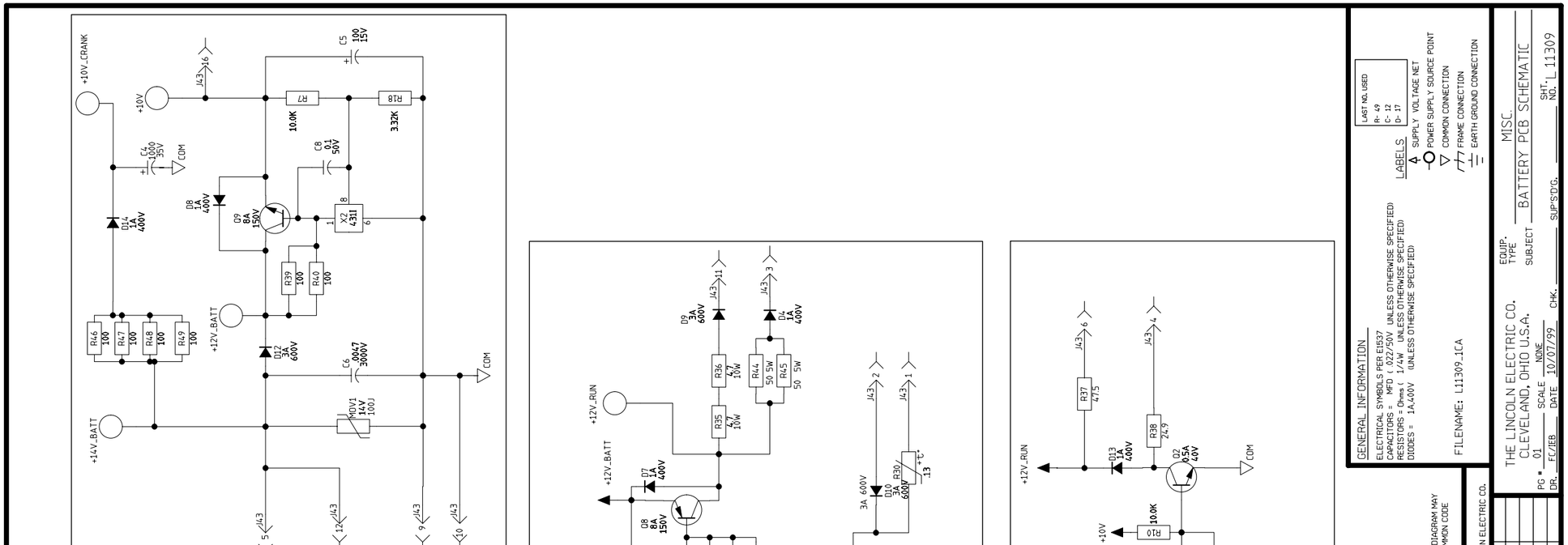
THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

EQUIP. TYPE: Multi-System
SUBJECT: Analog Control Power Supply
PG # 01 SCALE NONE
DR. TK DATE 09/02/99 CHK. _____ SUP'S'D'G. _____
SHT. NO. M 19422

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

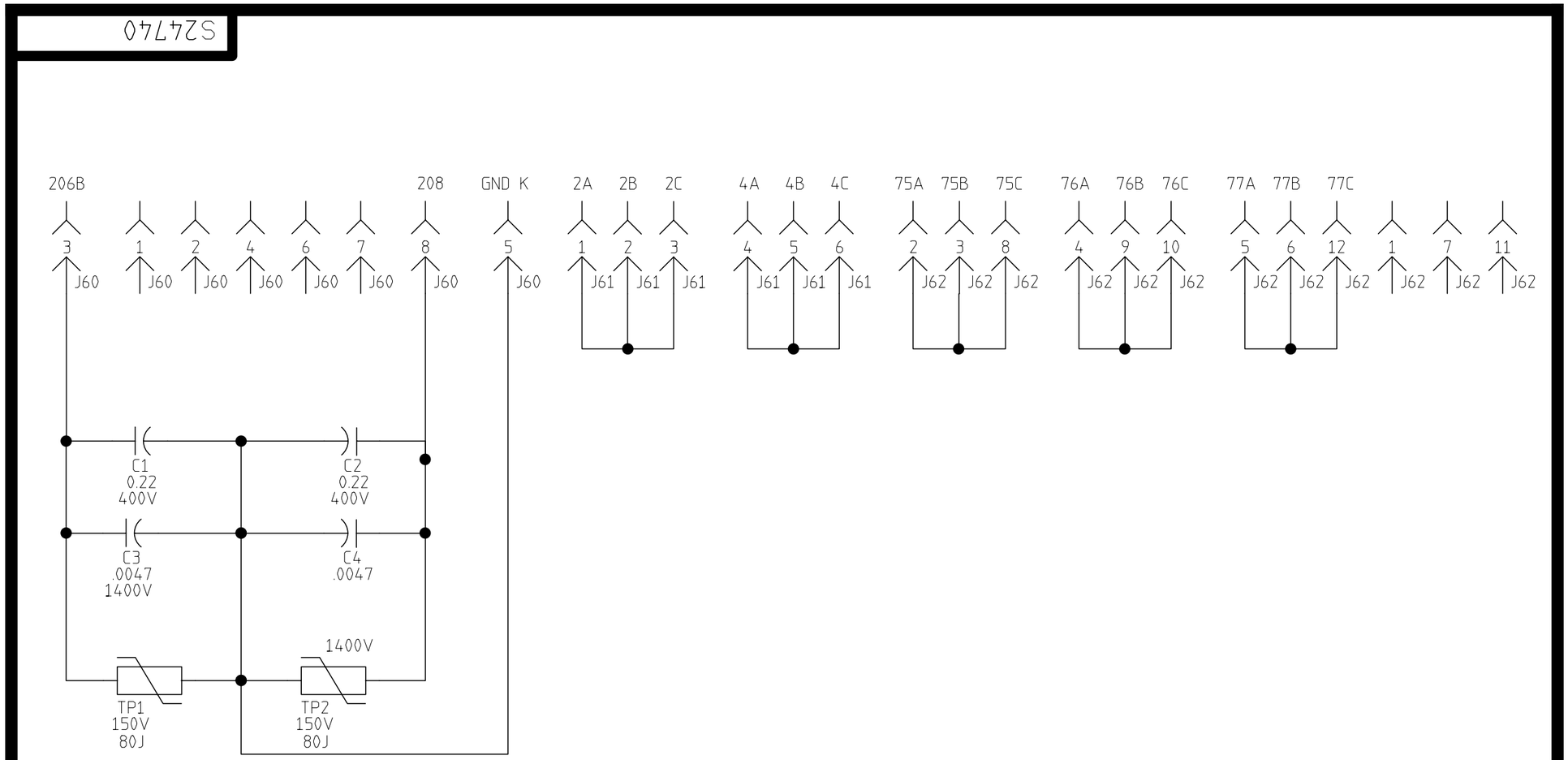
SCHEMATIC - BATTERY PRINTED CIRCUIT BOARD



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

SCHEMATIC - BYPASS PRINTED CIRCUIT BOARD



THIS SHEET CONTAINS PROPRIETARY INFORMATION OWNED BY THE LINCOLN ELECTRIC CO. AND IS NOT TO BE REPRODUCED, DISCLOSED OR USED WITHOUT THE EXPRESS PERMISSION OF THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.

NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD. THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (--------- UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (----- UNLESS OTHERWISE SPECIFIED)
DIODES = -------- (UNLESS OTHERWISE SPECIFIED)

LABELS

SUPPLY VOLTAGE NET
POWER SUPPLY SOURCE POINT
COMMON CONNECTION
FRAME CONNECTION
EARTH GROUND CONNECTION

LAST NO. USED	
R-	-
C-	4
D-	-

FILENAME: S24740_2BA

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLES SIZES PER E2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE
WITH PUBLISHED STANDARDS

DO NOT SCALE THIS DRAWING

Chg. Sheet No.		"X" INFO
3-31-2000		XM5644
		XB

DESIGN INFORMATION	
DRAWN BY: FM	
ENGINEER: PARMELEE	
REVISED BY: ---	

EQUIPMENT TYPE: ENGINE WELDERS

SUBJECT: BYPASS PCB SCHEMATIC

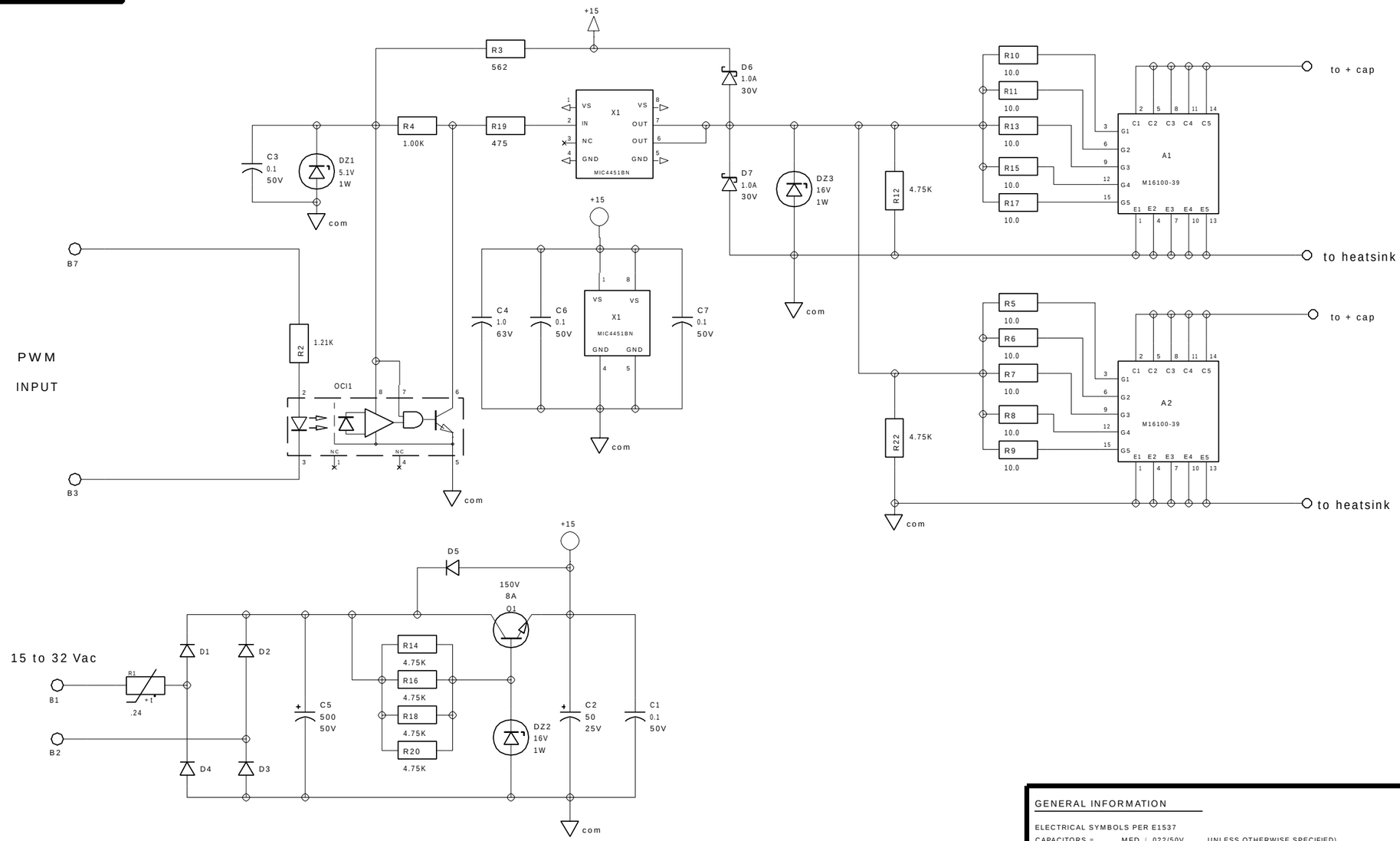
DATE: 03/23/00 SCALE: NONE REF.: ------ DRWG. NO. S24740

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

SCHEMATIC - CHOPPER PRINTED CIRCUIT BOARD

M 19462



NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (1/4W UNLESS OTHERWISE SPECIFIED)
DIODES = 1A, 400V (UNLESS OTHERWISE SPECIFIED)

LAST NO. USED	
R- 22	X- 1
C- 7	OCI- 1
D- 7	DZ- 3

LABELS

- SUPPLY VOLTAGE NET
- POWER SUPPLY SOURCE POINT
- COMMON CONNECTION
- FRAME CONNECTION
- EARTH GROUND CONNECTION

FILENAME: M19462_1BA

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AND IS NOT TO BE REPRODUCED, DISCLOSED OR USED WITHOUT THE EXPRESS PERMISSION OF THE LINCOLN ELECTRIC CO.

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLES SIZES PER E-2056
ON 2 PLACE DECIMALS IS + .02
ON 3 PLACE DECIMALS IS + .002
ON ALL ANGLES IS + .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS

Ch'ge.Sht.No.				
XC-RW				
4-14-2000				

THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

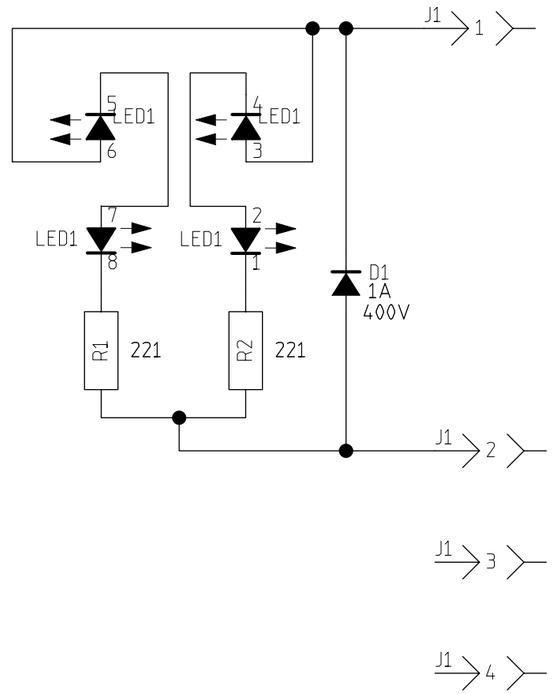
EQUIP. TYPE: CHOPPER, 300 AMP
SUBJECT: SCHEMATIC
SCALE: NONE
DR. LC DATE 3/26/99 CHK. _____ SUP'S'D'G. _____ SHT. NO. M 19462

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

SCHEMATIC - DISPLAY PRINTED CIRCUIT BOARD

S24660



THIS SHEET CONTAINS PROPRIETARY INFORMATION OWNED BY THE LINCOLN ELECTRIC CO. AND IS NOT TO BE REPRODUCED, DISCLOSED OR USED WITHOUT THE EXPRESS PERMISSION OF THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.

NOTES :

N.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD. THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

GENERAL INFORMATION

ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (--------UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (-----UNLESS OTHERWISE SPECIFIED)
DIODES = --------(UNLESS OTHERWISE SPECIFIED)

LABELS

SUPPLY VOLTAGE NET
POWER SUPPLY SOURCE POINT
COMMON CONNECTION
FRAME CONNECTION
EARTH GROUND CONNECTION

LAST NO. USED	
R-	2
C-	-
D-	1

FILENAME: S24660_1AC

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLES SIZES PER E2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS

DO NOT SCALE THIS DRAWING

Chg. Sheet No.	
3-31-2000	

"X" INFO
XM5644
XA

DESIGN INFORMATION	
DRAWN BY: IEB	
ENGINEER: ~~IEB~~	
REVISED BY: ---	

EQUIPMENT TYPE: ENGINE WELDERS

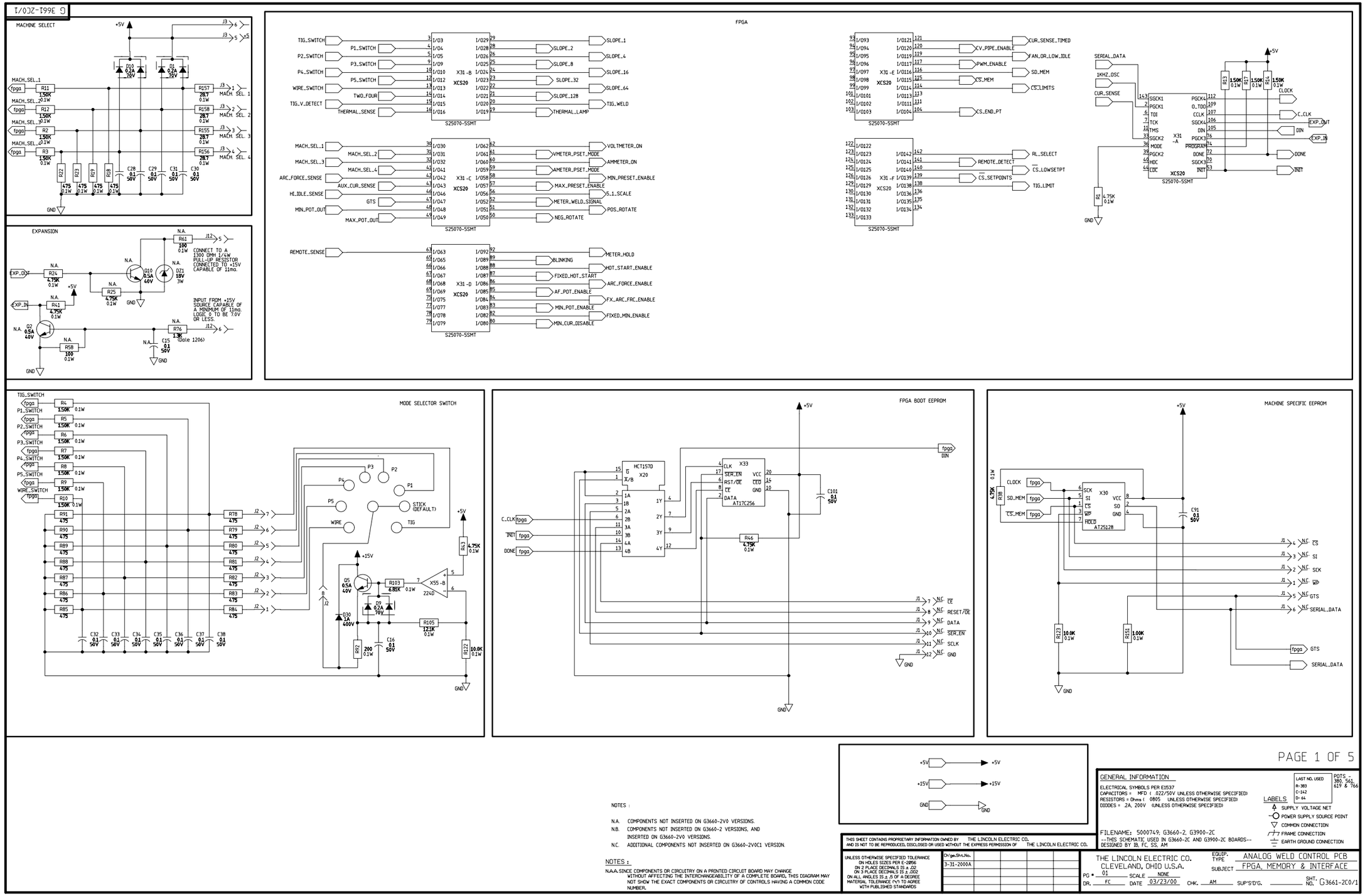
SUBJECT: DISPLAY PCB SCHEMATIC

DATE: 03/23/00 SCALE: NONE REF.: ------ DRWG. NO. S 24660

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

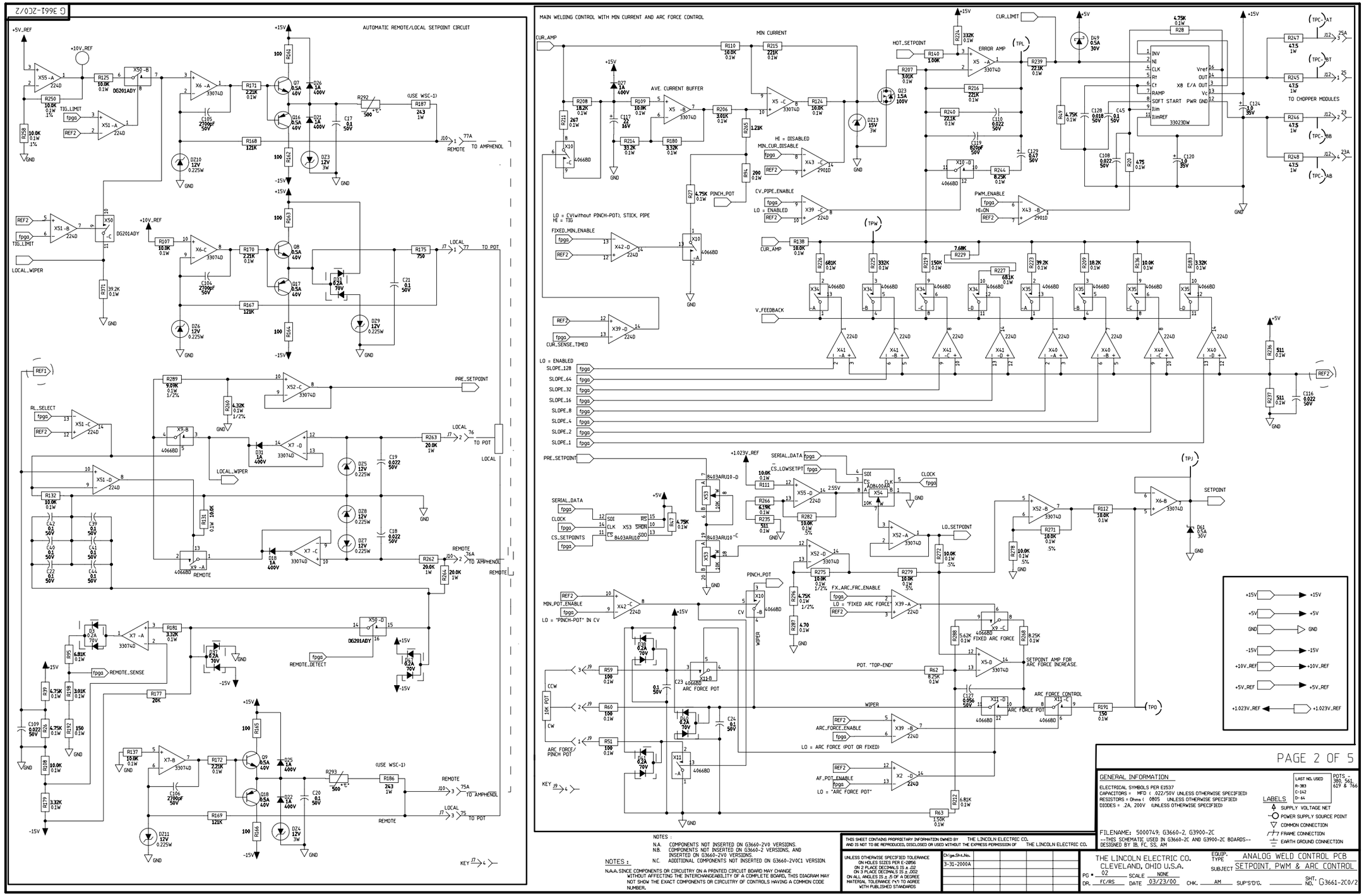
SCHEMATIC - WELD CONTROL PRINTED CIRCUIT BOARD - SHEET 1



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC
Return to Section TOC
Return to Master TOC

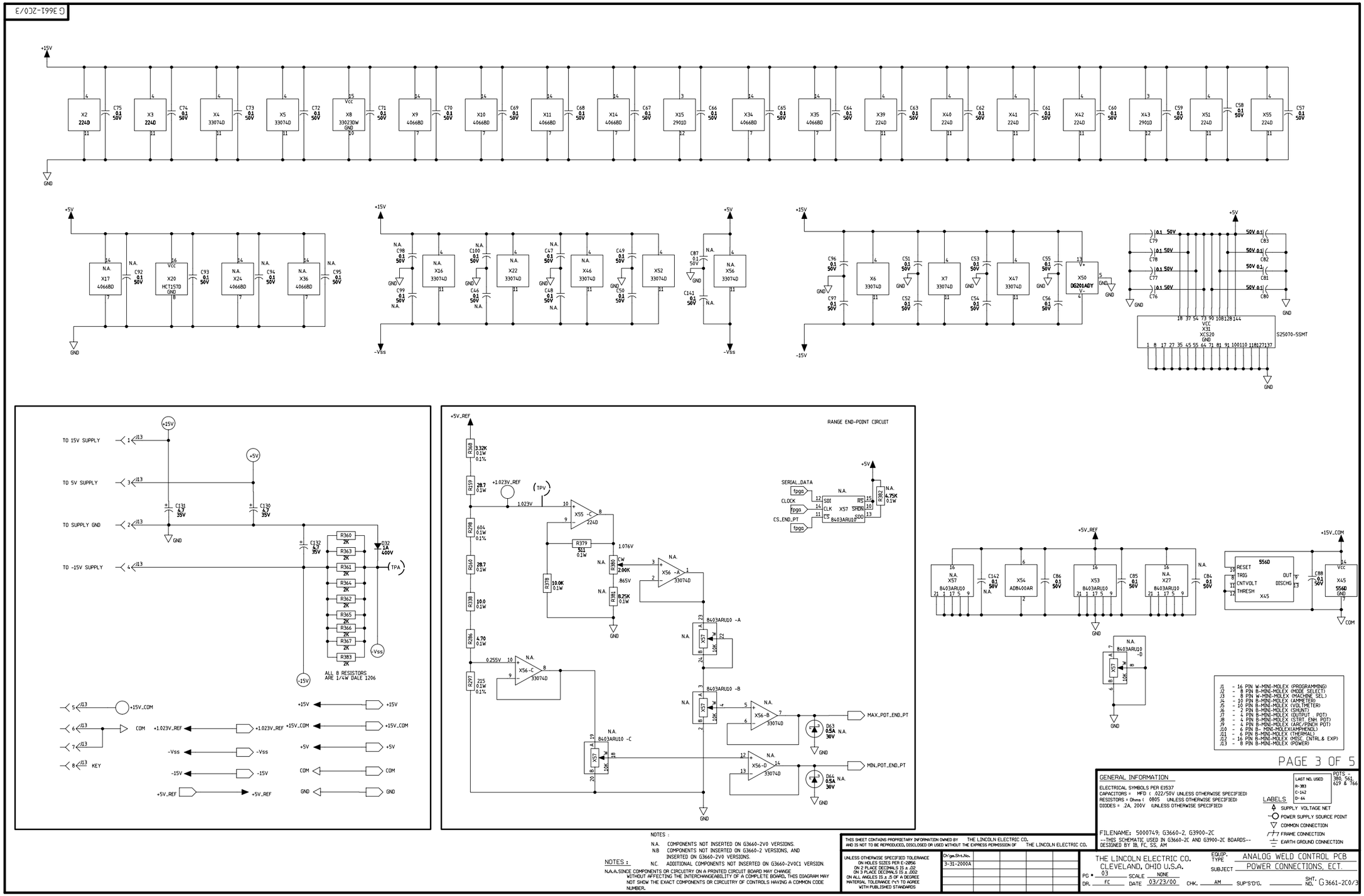
SCHEMATIC - WELD CONTROL PRINTED CIRCUIT BOARD - SHEET 2


MAIN WELDING CONTROL WITH MIN CURRENT AND ARC FORCE CONTROL
AUTOMATIC REMOTE/LOCAL SETPOINT CIRCUIT
MIN CURRENT
AVE. CURRENT BUFFER
HOT_SETPOINT
ERROR AMP
CUR_LIMIT
MI = DISABLED
MIN_CUR_DISABLE
CV_PIPE_ENABLE
PWM_ENABLE
LO = CV(without PINCH-POT), STICK, PIPE
HI = TIG
FIXED_MIN_ENABLE
PINCH_POT
V_FEEDBACK
CUR_SENSE_TIMED
LO = ENABLED
SLOPE_128
SLOPE_64
SLOPE_32
SLOPE_16
SLOPE_8
SLOPE_4
SLOPE_2
SLOPE_1
PRE_SETPOINT
SERIAL_DATA
CLOCK
CS_SETPOINTS
CS_LOWSETPT
LO_SETPOINT
SETPOINT
MIN_POT_ENABLE
LO = "PINCH-POT" IN CV
FX_ARC_FRC_ENABLE
LO = "FIXED ARC FORCE"
SETPOINT AMP FOR ARC FORCE INCREASE.
ARC FORCE CONTROL
ARC FORCE POT
ARC FORCE/ PINCH POT
ARC_FORCE_ENABLE
LO = ARC FORCE (POT OR FIXED)
AF_POT_ENABLE
LO = "ARC FORCE POT"
POT. "TOP-END"
WIPER
CCW
CW
10K POT
TO CHOPPER MODULES
TO AMPHENOL
REMOTE
LOCAL
TO POT
LOCAL_WIPER
REMOTE_SENSE
REMOTE_DETECT
KEY
PAGE 2 OF 5
GENERAL INFORMATION
ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (0805 UNLESS OTHERWISE SPECIFIED)
DIODES = 2A, 200V (UNLESS OTHERWISE SPECIFIED)
LABELS
SUPPLY VOLTAGE NET
POWER SUPPLY SOURCE POINT
COMMON CONNECTION
FRAME CONNECTION
EARTH GROUND CONNECTION
FILENAME: 5000749; G3660-2, G3900-2C
--THIS SCHEMATIC USED IN G3660-2C AND G3900-2C BOARDS--
DESIGNED BY JB, FC, SS, AM
NOTES :
N.A. COMPONENTS NOT INSERTED ON G3660-2V0 VERSIONS.
N.B. COMPONENTS NOT INSERTED ON G3660-2 VERSIONS, AND INSERTED ON G3660-2V0 VERSIONS.
N.C. ADDITIONAL COMPONENTS NOT INSERTED ON G3660-2V0C1 VERSION.
N.A.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.
THIS SHEET CONTAINS PROPRIETARY INFORMATION OWNED BY THE LINCOLN ELECTRIC CO. AND IS NOT TO BE REPRODUCED, DISCLOSED OR USED WITHOUT THE EXPRESS PERMISSION OF THE LINCOLN ELECTRIC CO.
UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLES SIZES PER E-2856 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE (*) TO AGREE WITH PUBLISHED STANDARDS
Ch'ge.Sh.t.No.
3-31-2000A
THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.
EQUIP. TYPE ANALOG WELD CONTROL PCB
SUBJECT SETPOINT, PWM & ARC CONTROL
PG # 02 SCALE NONE
DR. FC/RS DATE 03/23/00 CHK. AM SUP'S'D'G. SHT. NO. G3661-2C0/2
LAST NO. USED R-383 C-142 D- 64
PCTS - 380, 542, 619 & 766

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

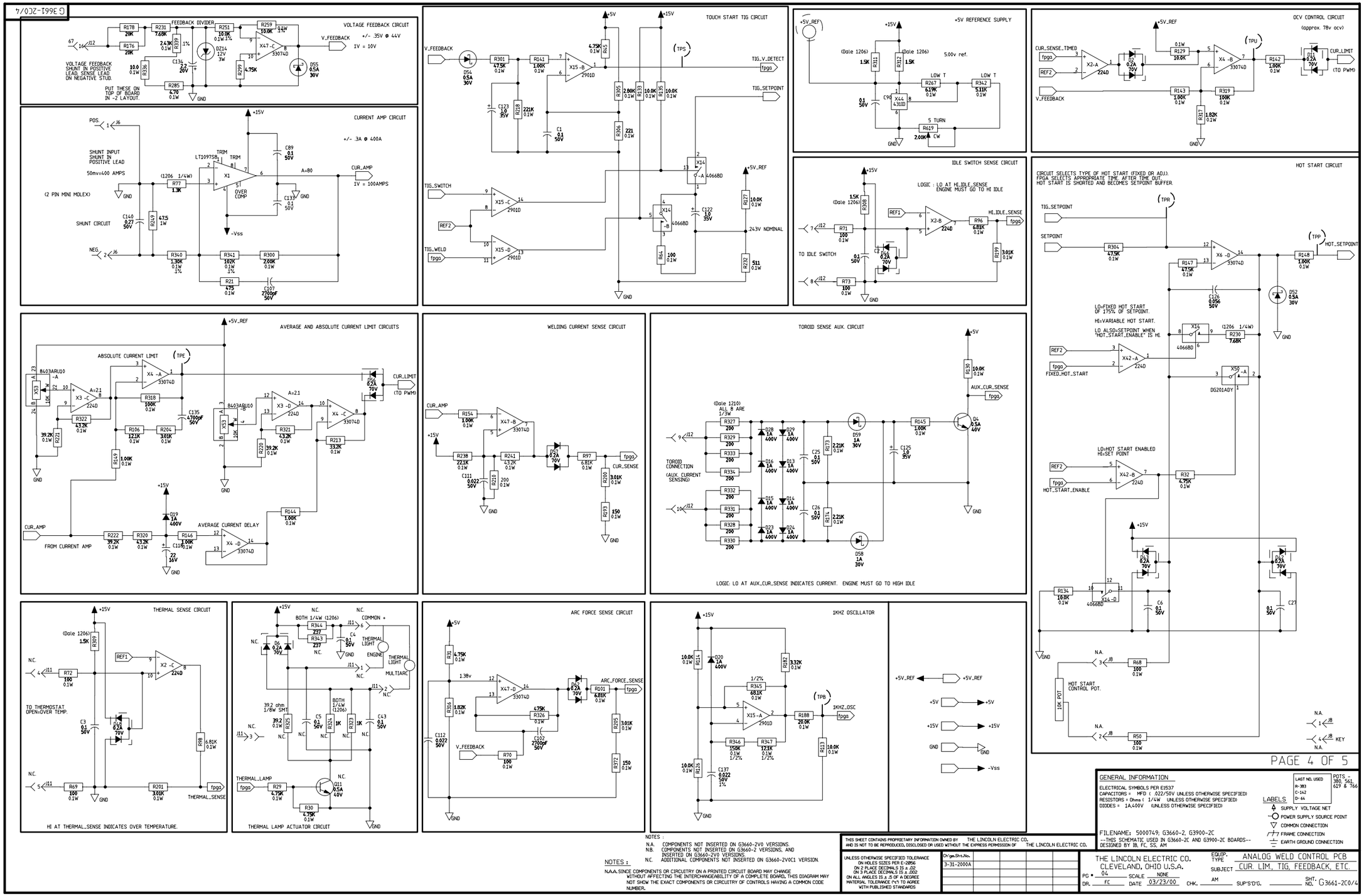
SCHEMATIC - WELD CONTROL PRINTED CIRCUIT BOARD - SHEET 3



NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

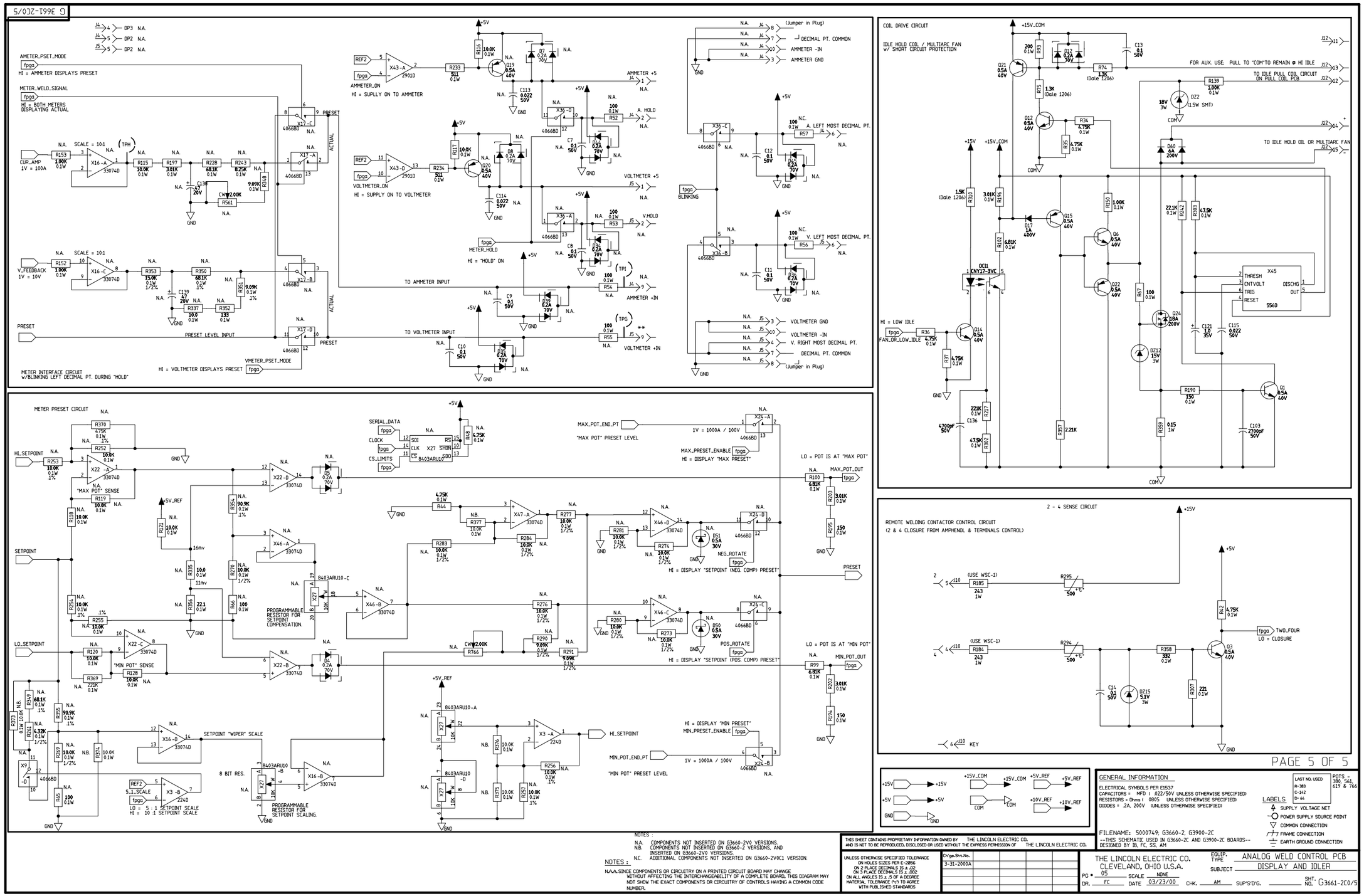
SCHEMATIC - WELD CONTROL PRINTED CIRCUIT BOARD - SHEET 4


G3661-2C0/4
VOLTAGE FEEDBACK CIRCUIT
FEEDBACK DIVIDER
V_FEEDBACK
+/- 35V @ 44V
1V = 10V
VOLTAGE FEEDBACK SHUNT IN POSITIVE LEAD, SENSE LEAD ON NEGATIVE STUD.
PUT THESE ON TOP OF BOARD IN -Z LAYOUT.
CURRENT AMP CIRCUIT
+/- 3A @ 400A
SHUNT INPUT
SHUNT IN POSITIVE LEAD
50mv=400 AMPS
(2 PIN MINI MOLEX)
SHUNT CIRCUIT
LT1097S8
CUR_AMP
1V = 100AMPS
TOUCH START TIG CIRCUIT
TIG_V_DETECT
TIG_SETPOINT
TIG_SWITCH
TIG_WELD
243V NOMINAL
+5V REFERENCE SUPPLY
5.00v ref.
LOW T
5 TURN
IDLE SWITCH SENSE CIRCUIT
LOGIC : LO AT HI_IDLE_SENSE
ENGINE MUST GO TO HI IDLE
TO IDLE SWITCH
HI_IDLE_SENSE
OCV CONTROL CIRCUIT
(approx. 78v ocv)
CUR_SENSE_TIMED
CUR_LIMIT
(TO PWM)
HOT START CIRCUIT
CIRCUIT SELECTS TYPE OF HOT START (FIXED OR ADJ.).
FPGA SELECTS APPROPRIATE TIME AFTER TIME OUT.
HOT START IS SHORTED AND BECOMES SETPOINT BUFFER.
TIG_SETPOINT
SETPOINT
HOT_SETPOINT
LO=FIXED HOT START OF 175% OF SETPOINT.
HI=VARIABLE HOT START.
LO_ALSO=SETPOINT WHEN "HOT_START_ENABLE" IS HI.
FIXED_HOT_START
LO=HOT START ENABLED
HI=SET POINT
HOT_START_ENABLE
HOT START CONTROL POT.
10K POT
KEY
AVERAGE AND ABSOLUTE CURRENT LIMIT CIRCUITS
ABSOLUTE CURRENT LIMIT
AVERAGE CURRENT DELAY
FROM CURRENT AMP
WELDING CURRENT SENSE CIRCUIT
CUR_SENSE
TOROID SENSE AUX. CIRCUIT
TOROID CONNECTION (AUX. CURRENT SENSING)
AUX_CUR_SENSE
LOGIC: LO AT AUX_CUR_SENSE INDICATES CURRENT. ENGINE MUST GO TO HIGH IDLE
THERMAL SENSE CIRCUIT
TO THERMOSTAT OPEN=OVER TEMP.
THERMAL_SENSE
HI AT THERMAL_SENSE INDICATES OVER TEMPERATURE.
THERMAL LAMP ACTUATOR CIRCUIT
THERMAL_LAMP
ARC FORCE SENSE CIRCUIT
ARC_FORCE_SENSE
1KHZ OSCILLATOR
1KHZ_OSC
NOTES :
N.A. COMPONENTS NOT INSERTED ON G3660-2V0 VERSIONS.
N.B. COMPONENTS NOT INSERTED ON G3660-2 VERSIONS, AND INSERTED ON G3660-2V0 VERSIONS.
N.C. ADDITIONAL COMPONENTS NOT INSERTED ON G3660-2V0C1 VERSION.
NOTES :
N.A.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.
GENERAL INFORMATION
ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (1/4W UNLESS OTHERWISE SPECIFIED)
DIODES = 1A,400V (UNLESS OTHERWISE SPECIFIED)
LABELS
SUPPLY VOLTAGE NET
POWER SUPPLY SOURCE POINT
COMMON CONNECTION
FRAME CONNECTION
EARTH GROUND CONNECTION
FILENAME: 5000749; G3660-2, G3900-2C
--THIS SCHEMATIC USED IN G3660-2C AND G3900-2C BOARDS--
DESIGNED BY JB, FC, SS, AM
PAGE 4 OF 5
THIS SHEET CONTAINS PROPRIETARY INFORMATION OWNED BY THE LINCOLN ELECTRIC CO. AND IS NOT TO BE REPRODUCED, DISCLOSED OR USED WITHOUT THE EXPRESS PERMISSION OF THE LINCOLN ELECTRIC CO.
UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLES SIZES PER E-2056 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE (*s*) TO AGREE WITH PUBLISHED STANDARDS
THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.
EQUIP. ANALOG WELD CONTROL PCB
TYPE
SUBJECT CUR. LIM, TIG, FEEDBACK, ETC.
SCALE NONE
DATE 03/23/00
SHT. NO. G3661-2C0/4

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

Return to Section TOC
Return to Master TOC

SCHEMATIC - WELD CONTROL PRINTED CIRCUIT BOARD - SHEET 5


G 3661-2C0/5
METER INTERFACE CIRCUIT
w/BLINKING LEFT DECIMAL PT. DURING "HOLD"
METER PRESET CIRCUIT
COIL DRIVE CIRCUIT
IDLE HOLD COIL / MULTIARC FAN
w/ SHORT CIRCUIT PROTECTION
2 - 4 SENSE CIRCUIT
REMOTE WELDING CONTACTOR CONTROL CIRCUIT
(2 & 4 CLOSURE FROM AMPHENOL & TERMINALS CONTROL)
PAGE 5 OF 5
GENERAL INFORMATION
ELECTRICAL SYMBOLS PER E1537
CAPACITORS = MFD (.022/50V UNLESS OTHERWISE SPECIFIED)
RESISTORS = Ohms (0805 UNLESS OTHERWISE SPECIFIED)
DIODES = .2A, 200V (UNLESS OTHERWISE SPECIFIED)
FILENAME: 5000749, G3660-2, G3900-2C
--THIS SCHEMATIC USED IN G3660-2C AND G3900-2C BOARDS--
DESIGNED BY IB, FC, SS, AM
LABELS
SUPPLY VOLTAGE NET
POWER SUPPLY SOURCE POINT
COMMON CONNECTION
FRAME CONNECTION
EARTH GROUND CONNECTION
NOTES :
N.A. COMPONENTS NOT INSERTED ON G3660-2V0 VERSIONS.
N.B. COMPONENTS NOT INSERTED ON G3660-2 VERSIONS, AND INSERTED ON G3660-2V0 VERSIONS.
N.C. ADDITIONAL COMPONENTS NOT INSERTED ON G3660-2V0C1 VERSION.
NOTES :
N.A.A. SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.
THIS SHEET CONTAINS PROPRIETARY INFORMATION OWNED BY THE LINCOLN ELECTRIC CO. AND IS NOT TO BE REPRODUCED, DISCLOSED OR USED WITHOUT THE EXPRESS PERMISSION OF THE LINCOLN ELECTRIC CO.
UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLES SIZES PER E-2856 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE (*) TO AGREE WITH PUBLISHED STANDARDS
THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.
EQUIP. TYPE ANALOG WELD CONTROL PCB
SUBJECT DISPLAY AND IDLER
PG # 05 SCALE NONE
DR. FC DATE 03/23/00 CHK. AM SUP'S'D'G.
SHT. NO. G3661-2C0/5

NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

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SVM ERROR REPORTING FORM

We need to know if there are errors in our manuals. We also value any suggestions as to additional tests or procedures that would make this SVM a better tool for you.

If you discover new or different “Problems or Symptoms” that are not covered in the three column troubleshooting chart, please share this information with us. Please include the machine’s code number and how the problem was resolved.

Thank You,
Technical Services Group
Lincoln Electric Co.
22801 ST. Clair Ave.
Cleveland, Ohio 44117-1199

FAX 216-481-2309

SVM Number _____

Page Number if necessary_____

Your Company_____

Your Name_____

Please give detailed description below:

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SD287 01/99

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